Barton Springs
Edwards Aquifer
CONSERVATION DISTRICT

COMPILATION OF PUMPING TESTS IN TRAVIS AND HAYS COUNTIES, CENTRAL TEXAS

BSEACD
Data Series Report 2010-0701
July 2010

Barton Springs/Edwards Aquifer Conservation District
1124 Regal Row
Austin, Texas

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Cover: Clockwise from upper left, photographs of pumping wells taken during pumping tests at: the Higginbotham Tract (Edwards), KBDJ Quarry (Middle Trinity), Estates of Shady Hollow (Edwards), and Ruby Ranch #5 (Middle Trinity).

COMPILATION OF PUMPING TESTS IN TRAVIS AND HAYS COUNTIES, CENTRAL TEXAS

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Hydraulic Conductivity (K)

Meters per day (m/d)	Feet per day (ft/d)	Gallons per day per square foot (gpd/ft^2)
1	3.28	24.5
0.305	1	7.48
0.0041	0.134	1

Transmissivity (T)

Square meters per day (m^2/d)	Square feet per day (ft^2/d)	Gallons per day per foot (gpd/ft)
1	10.76	80.5
0.0929	1	7.48
0.0124	0.134	1

Flow Rates

Cubic feet per second (cfs)	Cubic meters per second (cms)	Cubic meters per minute (cmm)	Cubic feet per minute (cf/min)	Gallons per minute (gal/min)	Acre-feet per year (ac-ft/yr)	Gallons per year (gal/yr)	Gallons per day (gal/day)
1	0.0283	1.7	60.00	449	723.97	235,905,352	646,272
35.30	1	60	2118.00	15,843	25556.03	8,327,458,928	22,813,402
0.588	0.0166	1	35.3	264	425.69	138,712,347	380,008
0.0167	0.000473	0.0284	1	7.49	12.09	3,939,619	10,793
0.0023	0.000065	0.00391	0.138	1	1.67	542,582	1,486
0.00138	3.91E-05	0.002346	0.08	0.62	1	325,549	892
4.24E-09	1.2E-10	7.21E-09	2.54E-07	1.90E-06	3.07E-06	1	2.74E-03
1.55E-06	4.38E-08	2.63E-06	9.28E-05	6.94E-04	1.12E-03	365	1

Conversions modified from Heath (1983).

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ABSTRACT

Groundwater is an important natural resource for Central Texas, providing the sole source of water in many areas, for municipal, domestic, industrial, livestock, and ecological needs. To sustainably manage the groundwater resources it is essential to have data that characterize the hydraulic parameters of the aquifers. This type of data is often not readily available. This document compiles reports of 85 pumping tests conducted in Central Texas and presents key information summarized from each report, including hydraulic parameters such as hydraulic conductivity, transmissivity, and storativity. Location maps of the tests are provided, along with statistical summaries in the form of tables and box plots. The summarized hydraulic data in this report are compared to ranges of published values. The results of this compilation indicate that the highest transmissivity and storativity values are within the Edwards Aquifer, followed by the Middle Trinity, the Lower Trinity, and the Upper Trinity Aquifers. Pumping tests are an important method for determining hydraulic parameters. The data presented in this report will be useful to future groundwater modeling, groundwater availability, and other aquifer studies.

INTRODUCTION

Groundwater is an important resource for Central Texas, often providing the sole source of water for municipal, domestic, industrial, livestock, and ecological needs. To sustainably manage the groundwater resources it is essential to have data that characterize the hydraulic parameters of the aquifers that form these resources. Hydrogeologic parameters such as hydraulic conductivity, transmissivity, and storativity are often calculated from pumping tests. These data can then be used, in conjunction with other data, to estimate the temporal and spatial effects of current and projected pumpage on the aquifers.

This report contains a compilation of 85 pumping test reports conducted in Central Texas along with the key information summarized from each report including: aquifer, pumping wells, observations wells, and the hydraulic parameters derived from the analyses of the test data (such as hydraulic conductivity, transmissivity, and storativity). The purpose of this report is to compile data that is received and archived at various sources and to provide a data resource to support future hydrogeologic investigations.

OVERVIEW OF DATA

Eighty-five pumping-test reports were compiled, scanned, and their information summarized in tables and appendices in this report. Some of the reports document tests performed on multiple wells, and where possible, data were extracted for each tested well resulting in about 96 tests summarized in **Appendix 1**. All the reports summarized in this document are provided digitally on CD as **Appendix 4**. The reports contained in this document were mostly obtained through publically available data sources and include County Water Availability Studies (WAS), BSEACD hydrogeologic reports, and the Texas Water Development Board well database (**Table 1**). However, a few reports are unpublished or are draft reports from consultants. **Table 2** is a summary of the number of tests by aquifers. **Table 3** is a listing of the tests (sorted by latitude) that are located on **Figures 1 and 2**.

Appendix 2 provides an overview and requirements by county for WAS reports. The Hays-Trinity Groundwater Conservation District and GEOS Consulting provided many of the WAS reports. In addition, the BSEACD requires pumping tests as part of authorizing large-volume groundwater withdrawals (**Appendix 3**). There are also a few reports that were derived from the Texas Water Development Board well database.

Table 1. Reports Source Data

Source data	Percentage (% of total)
County* WAS	52
BSEACD permits	43
TWDB and others	5

**Primarily Hays County*

Table 2. Summary of Tests by Aquifer

Aquifer	No. Tests*
Edwards	42**
Upper Trinity	4
Middle Trinity	35
Lower Trinity	11
Ellenburger-San Saba	1
Simsboro (Carrizo-Wilcox)	1
Wilcox (Upper Calvert Bluff)	1
Sum	**95***

* approximate number, some reports have multiple tests
**includes 1 Edwards-Upper Trinity hybrid completion

Photograph of water-level monitoring with an e-line during KBDJ Quarry Middle Trinity pumping test.

Table 3. General Inventory of Pumping Test Reports and Map Key. *Wells are sorted by latitude.*

Map ID	Name	Aquifer
1	Lantana Ridge	Middle Trinity
2	Bridlewood No. 1	Middle Trinity
3	Bridlewood (West Windmill)	Edwards
4	Cielo	Middle Trinity
5	Little Arkansas	Upper Trinity
6	Las Misiones	Middle Trinity
7	Hermosa	Upper Trinity
8	River Mountain	Upper & Middle Trinity
9	Pinnacle Ridge	Middle Trinity
10	Kyle No.4	Edwards
11	Mustang Ranch	Middle Trinity
12	Synergy Ranch	Wilcox (Upper; Calvert Bluff)
13	Monarch No. 4	Edwards
14	Plum Creek (Tecon) No. 3	Edwards
15	Goforth No.5	Edwards
16	Centex Well 415	Edwards
17	Ruby Ranch No. 5	Middle Trinity
18	Ruby Ranch No. 4	Edwards
19	Running Rope/Sierra West	Middle Trinity
20	Penbur Well	Edwards
21	Centex Well 414	Edwards
22	Kelly's Country	Middle Trinity
23	Buda No. 3	Edwards
24	Running Rope	Upper Trinity
25	Ruby Ranch No. 3	Edwards
26	Plum Creek (Tecon) No. 1	Edwards
27	Goforth No.4	Edwards
28	Ruby Ranch No. 1	Edwards
29	Buda No. 1	Edwards
30	Buda No. 2	Edwards
31	High View	Middle Trinity
32	Riverwild	Middle Trinity
33	Venado Ranch	Middle Trinity
34	Higginbotham Well	Edwards
35	Hunter	Edwards
36	Creek Ridge	Simsboro (Carrizo-Wilcox)
37	Mt. Sharp	Lower Trinity
38	Mandola	Middle Trinity
39	Leisurewoods No. 6	Edwards
40	Oak Forest	Middle Trinity
41	Cimarron Well No. 2	Edwards
42	Porter No. 1	Edwards
43	Huntington Estates No. 1	Edwards
44	Creedmoor-Maha Site 1	Edwards
45	Elliott Ranch No. 1	Edwards
46	Cimarron Well No. 3	Edwards
47	Elliott Ranch No. 2	Edwards
48	Porter No. 2	Edwards
49	Faith Dunn Ranches	Middle Trinity
50	Oaks at Gatlin Creek (TW-1)	Middle Trinity
51	Heatherwood	Middle Trinity
52	Creedmoor-Maha Site 2	Edwards
53	Homestead at Gatlin Creek	Middle Trinity
54	Manchaca Optimist Club	Edwards
55	Onion Creek Golf No. 3	Edwards
56	Onion Creek Golf No. 1 & 2	Edwards
57	Shady Hollow Well No. 1	Edwards
58	Brushy Top 2006 (RBT 1A)	Middle Trinity
59	Shady Hollow Well No. 2	Edwards
60	Kennedy Ranch	Middle Trinity
61	Brushy Top 2005 No. 3	Lower Trinity
62	Brushy Top 2006 (RBT 3A)	Lower Trinity
63	Chama Trace Pumping Well	Lower Trinity
64	Roger Hanks	Lower Trinity
65	Dos Lagos	Middle Trinity
66	Valley Verde	Middle Trinity
67	Foster Ranch/Belterra	Lower Trinity
68	Shady Valley	Middle Trinity
69	Capital Soccer	Edwards
70	Polo Club	Lower Trinity
71	Independence Park	Edwards
72	Sunset Valley	Edwards
73	Goldenview	Middle Trinity
74	Freescale (Well No. 2)	Middle and Lower Trinity
75	Freescale (Well No. 1)	Middle Trinity
76	Walnut Springs	Ellenburger-San Saba
77	St. Andrews No. 3	Middle Trinity
78	St. Andrews No. 2	Lower Trinity
79	Carr Well (Robert Small)	Middle Trinity
80	Fronterra	Lower Trinity
81	Deerfield Estates	Middle Trinity
82	Westridge	Middle Trinity
83	Heather Hills	Lower Trinity
84	Forrister Well	Edwards
85	Rudy's Bar-B-Q	Edwards
86	Driskill Hotel Well	Lower Trinity
87	Walking W Ranch	Middle Trinity
88	Woodlands	Middle Trinity
89	EMS Well	Middle Trinity

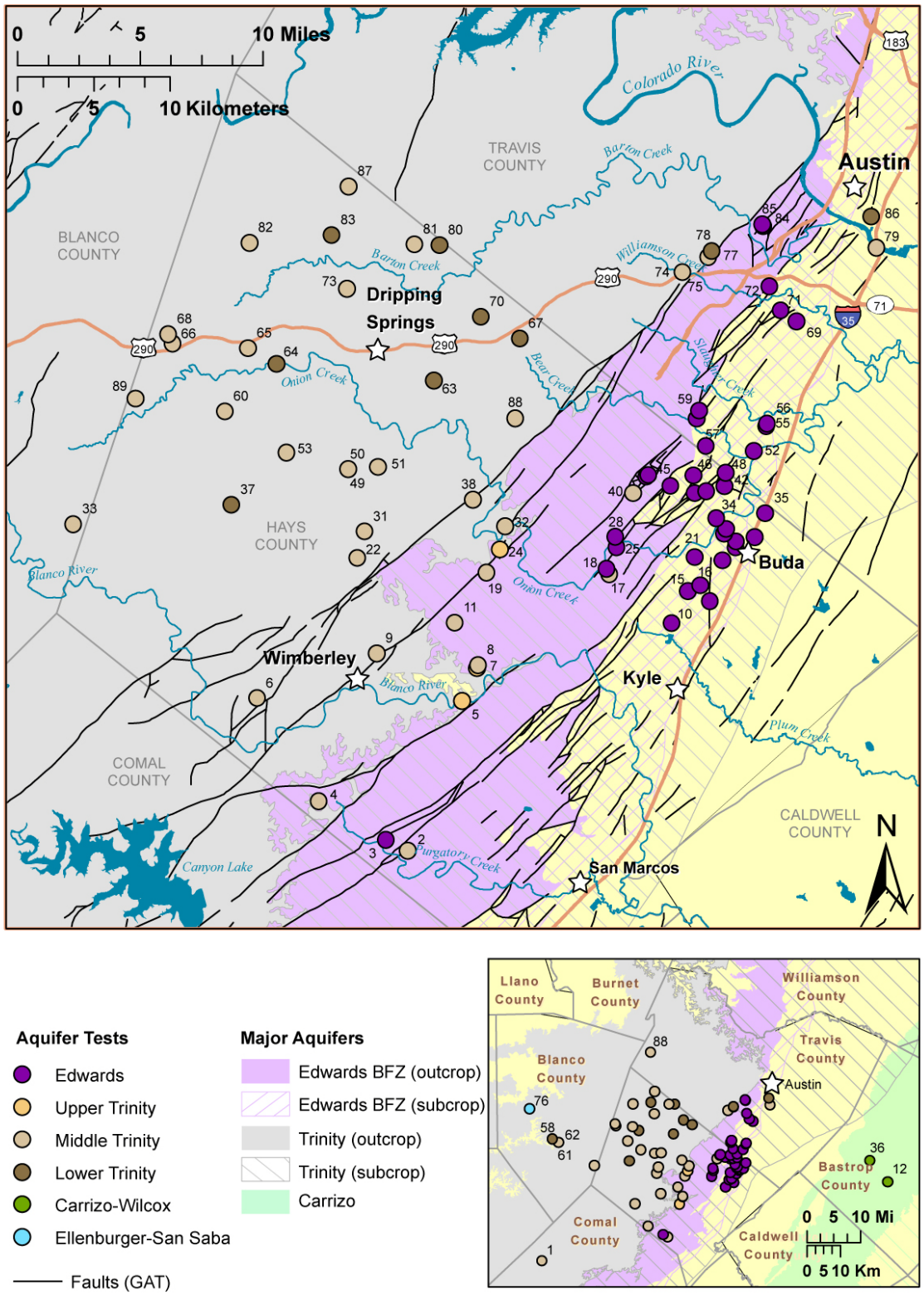

Figure 1. General Map of Major Aquifers and Location of Tests. *Major aquifers basemap from the TWDB.*

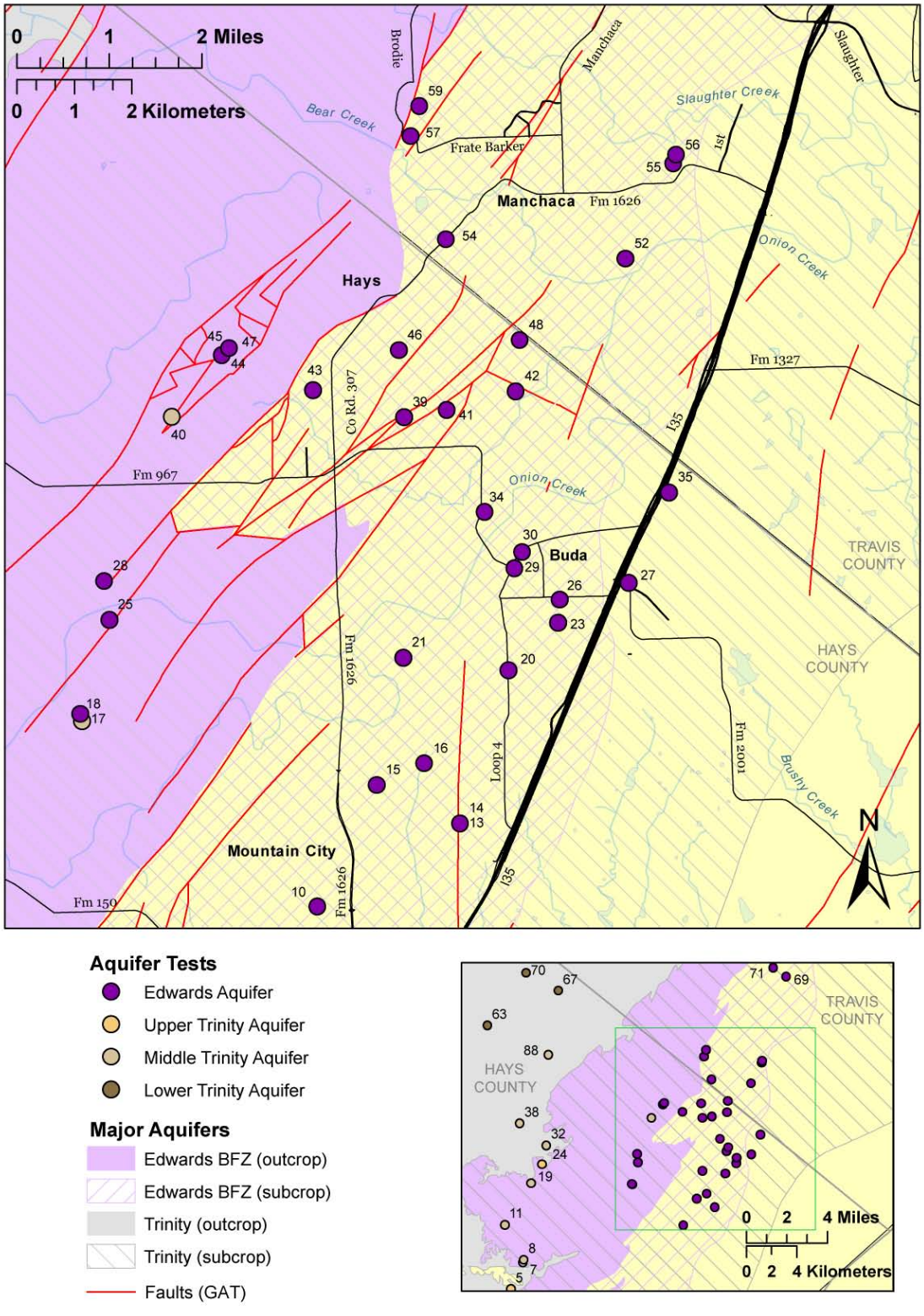

Figure 2. Detailed Map of Aquifers and Location of Tests.

HYDRAULIC PARAMETERS

An aquifer performs two primary functions: to store (porosity) and to transmit (permeability) water (Driscoll, 1986). Water-availability studies typically determine or estimate these aquifer characteristics with pumping-test data. Pumping tests are a common method for determining an aquifer's hydraulic parameters, including storativity (S), transmissivity (T), and hydraulic conductivity (K). **Appendix 1** contains a detailed summary of information and hydraulic parameters from each pumping test in this report.

Hydraulic Conductivity and Transmissivity

Hydraulic conductivity (K) is a measure of the volume of water that can move through porous media in a given interval of time under a given hydraulic gradient and is expressed in units of feet per day (ft/day) (Kruseman and Ridder, 1992). This property is primarily a function of the size and shape of pores and their interconnection. Transmissivity (T), which is the product of K multiplied by the saturated thickness of the aquifer, is the term commonly used in groundwater investigations and is expressed in terms of gallons per day per foot (gpd/ft). This term reflects the transmission capability of the entire thickness of an aquifer (Driscoll, 1986).

Tables 4 through 7 summarize results for hydraulic conductivity and transmissivity presented in **Appendix 1**. **Figures 3 and 4** are visual displays of the data by aquifer. All data summarized here were derived from the average of reported transmissivity values, or in some reports or tests the single value reported to be most reasonable (hereafter reported as "average"). Hydraulic conductivity was derived in this report by dividing the average transmissivity by the thickness of the aquifer as reported, or as estimated in other publications.

Figure 3 is a box plot of the range of transmissivity by aquifer. The data indicate that the values from each aquifer overlap in range. However, the median values indicate the Edwards Aquifer has the highest permeability followed by the Middle Trinity, Lower Trinity, and Upper Trinity Aquifers. The Upper Trinity Aquifer has relatively few tests and is presented here for comparison. The T values presented in **Figure 4** are within the range of karst limestone, limestone and dolomite and sandstone reported in Freeze and Cheery (1979).

Table 4. Summary of Average Hydraulic Conductivity Values by Aquifer

	Edwards K (ft/day)	Middle Trinity K (ft/day)	Lower Trinity K (ft/day)
Min	0.14	0.25	0.04
Max	334.81	53.60	6.70
Average	28.15	10.67	2.10
Median	5.71	4.99	1.34
Q1 (25%)	1.97	2.01	0.40
Q3 (75%)	23.05	8.38	2.55
n (count)	*38*	*30*	*8*

Table 5. Summary of Hydraulic Conductivity Values of Aquifers with Sparse Data

Aquifer	Average K (ft/day)
Wilcox (Upper Calvert Bluff)	6.700
Simsboro (Carrizo-Wilcox)	0.503
Upper Trinity Aquifer	0.058 and 0.095

Table 6. Summary of Average Transmissivity Values by Aquifer

	Edwards T (gpd/ft)	Upper Trinity T (gpd/ft)	Middle Trinity T (gpd/ft)	Lower Trinity T (gpd/ft)
Min	97	60	225	100
Max	774,565	231	12,716	10,000
Average	71,849	144	3,988	2,214
Median	15,000	143	2,275	1,500
Q1 (25%)	4,443	80	988	340
Q3 (75%)	70,250	208	6,300	2,750
n (count)	*40*	*4*	*34*	*11*

Table 7. Summary of Transmissivity Values of Aquifers with Sparse Data

Aquifer	Average Transmissivity (gpd/ft)
Ellenburger-San Saba	3
Simsboro (Carrizo-Wilcox)	750
Wilcox (Upper; Calvert Bluff)	7,500

Storativity

Storativity (S) is a dimensionless measure (coefficient) of the volume of water that can move into or out of a unit area of porous material, relative to a unit rise or drop of head. In effect, S is a measure of the percentage of total aquifer volume (aquifer matrix plus contained water) that can be released. The magnitude of S is highly influenced by the aquifer setting (i.e. confined or unconfined) and the compressibility of the aquifer material.

Tables 8 and 9 summarize storativity results from **Appendix 1**. **Figure 3** is a visual display of S by aquifer. All data summarized are the average of calculated storativity values, or the value reported to be most reasonable, from each report. About 60% of all tests in this document report storativity values estimated from the literature rather than being directly calculated; those values are indicated in **Appendix 1** with an "e." The primary reason for estimating the storage coefficients from the literature is due to a lack of measureable drawdown in observations wells, or the lack of observation

wells. Only S data derived from calculations using observation wells (i.e. no estimates from the literature) are presented in the tables and figures.

Figure 3 shows that S values range from 0.1 to 0.00001, with the interquartile range and median values indicating predominantly confined conditions where S < 0.001 (Weight and Sonderegger, 2001). Some S values in **Figure 3** fall in the range of leaky or semi-confined aquifer systems. Owing to the limits of the compressibility of water, storativity values less than 10^{-6} are considered to be impossible in porous media aquifers (Weight and Sonderegger, 2001).

The median S value for the Edwards was the highest, followed by the Middle Trinity, Lower Trinity, and the Upper Trinity Aquifers. However, there is relatively limited data from the Lower and Upper Trinity Aquifers.

Table 8. Summary of Average Storativity Values by Aquifer

	Edwards S (all data)	Edwards S (calc)	Upper Trinity S (all data)	Upper Trinity S (calc)	Middle Trinity S (all data)	Middle Trinity S (calc)	Lower Trinity S (all data)	Lower Trinity S (calc)
Min	6.29E-05	2.00E-04	1.0E-05	1.00E-05	1.85E-06	1.85E-06	4.00E-06	4.00E-06
Max	1.00E-01	1.00E-01	5.00E-03	1.30E-05	4.00E-02	3.40E-02	5.00E-03	5.00E-03
Average	6.10E-03	8.07E-03	1.26E-03	1.17E-05	3.56E-03	2.60E-03	8.40E-04	1.69E-03
Median	7.00E-04	8.50E-04	1.25E-05	1.20E-05	1.30E-04	5.00E-05	1.00E-04	5.00E-05
Q1 (25%)	3.54E-04	4.25E-04	1.15E-05	1.10E-05	4.01E-05	1.00E-05	5.00E-05	2.70E-05
Q3 (75%)	1.60E-03	1.15E-03	1.26E-03	1.25E-05	1.00E-03	1.00E-03	1.00E-03	2.53E-03
n (count)	*23*	*15*	*4*	*3*	*33*	*19*	*9*	*3*

Calc = calculated

Table 9. Summary of Storativity Values of Aquifers with Sparse Data

Aquifer	Reported Storativity	Calculated Storativity
Ellenburger-San Saba	9.00E-05	9.00E-05
Simsboro (Carrizo-Wilcox)	3.00E-04	nd
Wilcox (Upper; Calvert Bluff)	3.00E-04	3.00E-04

nd = no data

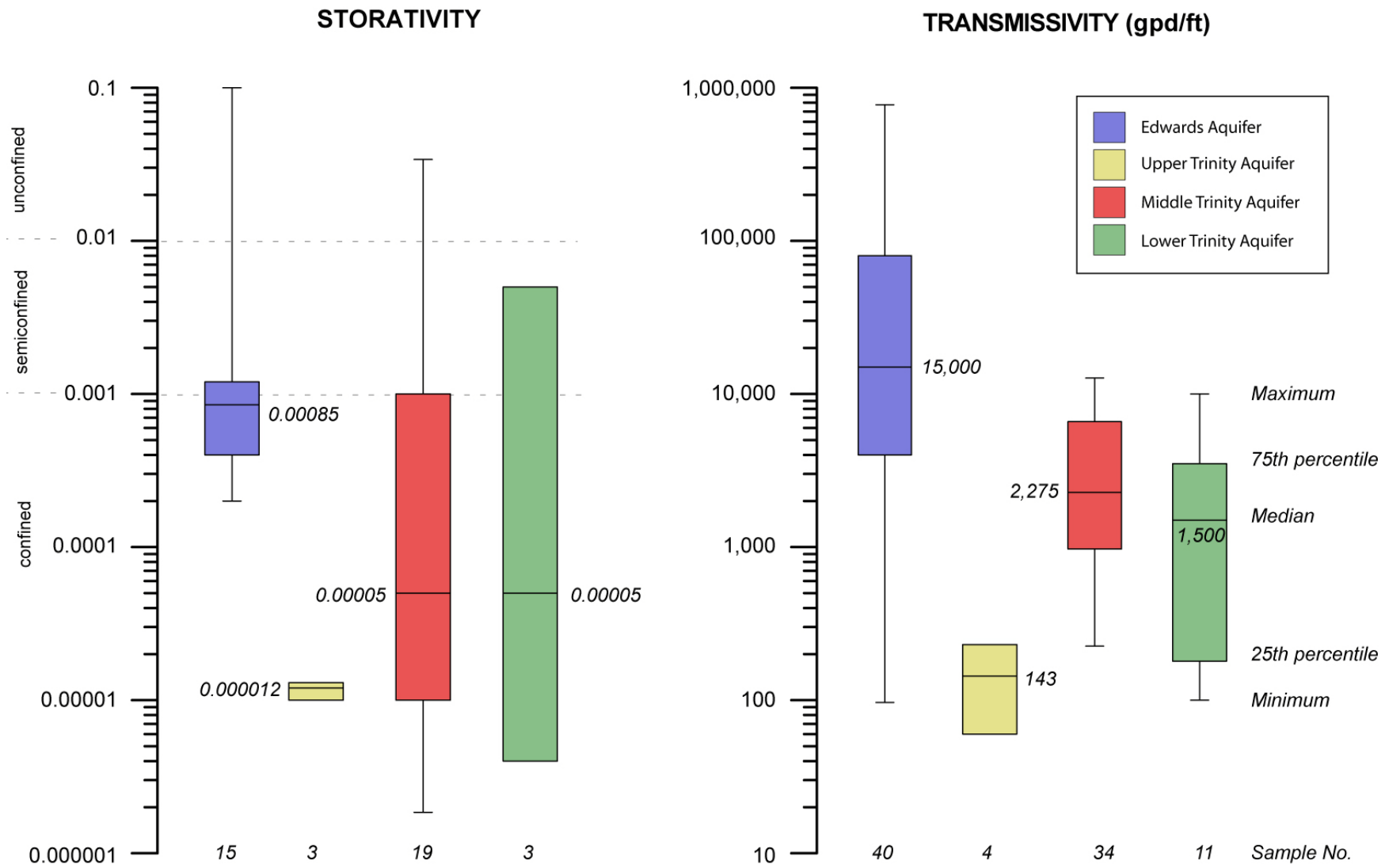

Figure 3. Box and Whisker Plot of Transmissivity and Storativity by Aquifer. *The range in storativity values for confined, semi-confined, and unconfined are approximate and derived from Weight and Sonderegger (2001).*

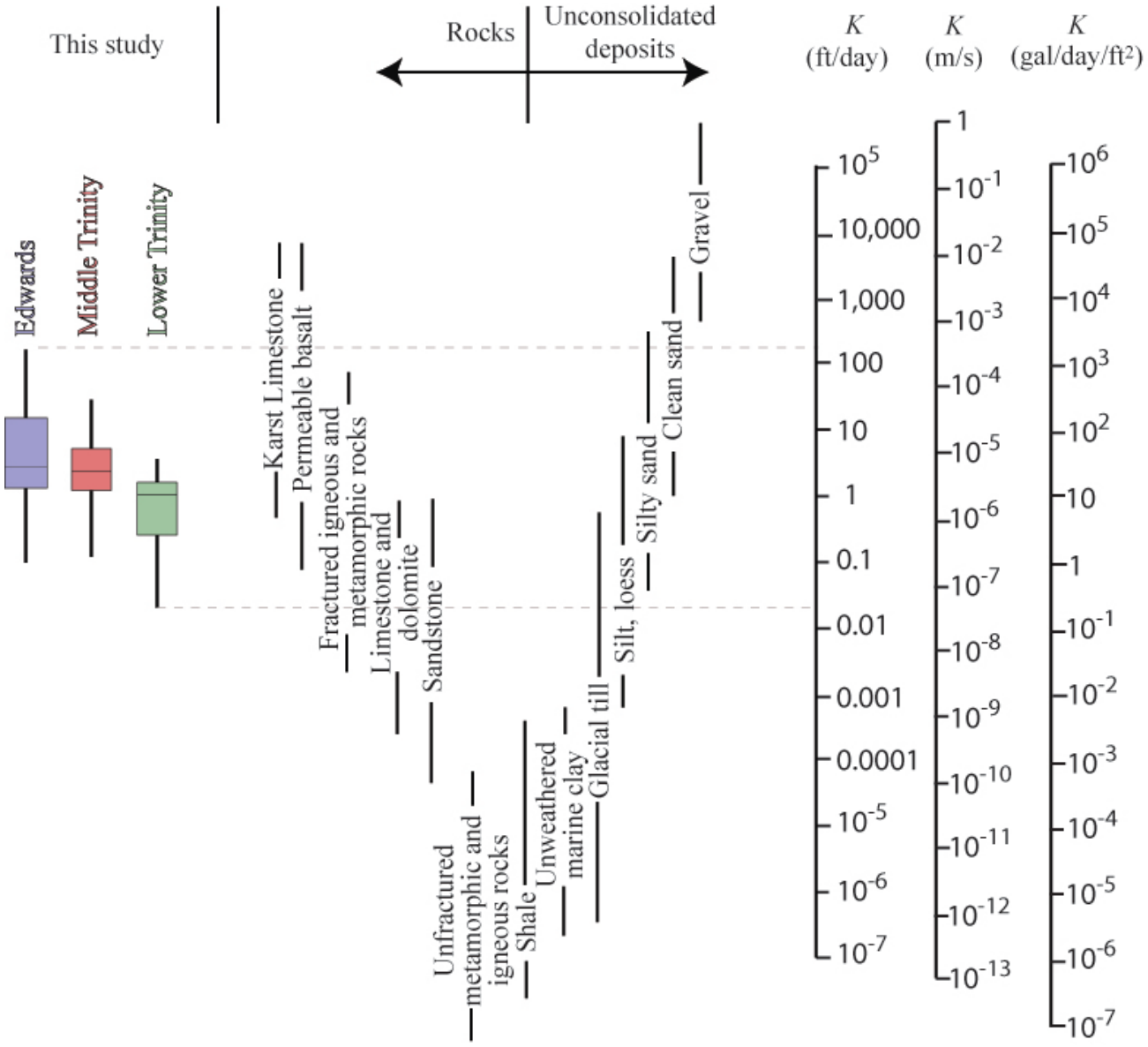

Figure 4. Comparison of K Values in Compiled Reports with Published Ranges in K Values. *Figure modified from Freeze and Cheery (1979) showing hydraulic conductivity for different rock and sediment types.*

ACKNOWLEDGMENTS

This compilation represents a tremendous amount of information and work by many consulting and agency geologists, hydrogeologists, and engineers. Their collective work and information are valued and appreciated.

For this compilation, Douglas A. Wierman, P.G. provided hard copies of Water Availability Studies (WAS) that the Hays-Trinity Groundwater Conservation District has compiled over the years. John K. Mikels, P.G. (GEOS Consulting) also provided numerous pumping test reports—some of the tests that he provided would never have reached the public if not for his efforts. Ronald Fieseler, P.G. also provided several pumping tests from Blanco County. Finally, over the years various District staff have helped plan, execute, and review many of the pumping tests from the BSEACD included in this compilation. Those individuals include: Nico Hauwert, Ph.D., P.G., Joe Beery, Brian B. Hunt, P.G., Brian A. Smith, Ph.D., P.G., Ronald Fieseler, P.G., Mark Mathis, Stefani Campbell, and Beckie Morris. Special thanks to Robin Gary for assisting the authors in making the maps (Figures 1 and 2).

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Heath, R., 1983, Basic Ground-Water Hydrology. U.S. Geological Survey Water-Supply Paper 2220, United States Government Printing Office, Denver, Colorado, 84 p.

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Weight, W.D., and J.L. Sonderegger, 2001, Manual of Applied Field Hydrogeology, McGraw-Hill, 608 p.

Appendix 1

Detailed Pumping Test Summary Table

Appendix 1: Detailed pumping test summary table.

GENERAL REPORT INFORMATION									
Abbreviated Name	**Map ID**	**Report Name**	**Well ID #**	**Date Report**	**Aquifer**	**Decimal Degrees Latitude**	**Decimal Degrees Longitude**	**Prepared by**	**County**
Lantana Ridge	**1**	Hydrogeologic Evaluation: Lantana Ridge No. 1 Testwell, Comal County, Texas	Lantana Ridge No. 1 Testwell	9/17/00	Middle Trinity	29.833118	-98.449720	GEOS Consulting	Comal
Bridlewood	**2**	Ground-Water Resource Investigation for the Bridlewood Ranches Development Hays County, Texas	Bridlewood No. 1 (68088--)	4/1/03	Middle Trinity	29.895567	-98.059483	LBG-Guyton Associates	Hays
Bridlewood	**3**	Ground-Water Resource Investigation for the Bridlewood Ranches Development Hays County, Texas	Bridlewood West Windmill	4/1/03	Edwards	29.902267	-98.074267	LBG-Guyton Associates	Hays
Cielo	**4**	Water Availability Study Cielo Ranch A Proposed Subdivision in Hays County, Texas (has updates by JM)	Cielo PW-1	11/1/04	Middle Trinity	29.925306	-98.119639	Banks & Associates, Erin K. Banks	Hays
Little Arkansas	**5**	Water Availability Investigation: Little Arkansas Tract, Hays County, Texas	Little Arkansas Well	1/2/00	Upper Trinity Aquifer	29.984011	-98.021742	GEOS Consulting	Hays
Las Misiones	**6**	Water Availability Certification Las Misiones Hill Country Estates Wimberley, Hays County, Texas	Las Misiones Well #3	6/1/05	Middle Trinity	29.986472	-98.160972	Premier Hydro	Hays
Hermosa	**7**	Water Availability Study Hermosa Paloma Subdivision Hays County, Texas	Hermosa PW-1	1/1/06	Upper Trinity Aquifer	30.003194	-98.011444	Banks & Associates, Erin K. Banks	Hays
River Mountain Ranch	**8**	Water Availability Investigation: River Mountain Ranch-Section 6, Phase 2 Hays County, Texas	RMR Test well (5764903)	7/27/01	Upper & Middle Trinity Aquifer	30.005000	-98.010833	GEOS Consulting	Hays
Pinnacle Ridge	**9**	Water Availability Study for Pinnacle Ridge Estates a Proposed Subdivision Hays County, Texas	Pinnacle Ridge PW-1	1/29/07	Middle Trinity	30.012583	-98.079639	Banks & Associates, Erin K. Banks	Hays
Kyle No.4	**10**	Well Testing and Hydrogeologic Report: City of Kyle Well No. 4 Hays County, Texas	Kyle No. 4 Well with Plum Creek (5857916) (--9N1)	1/1/98	Edwards	30.028830	-97.878740	GEOS Consulting, Wellspec Company, Kiva Productions	Hays
Kyle No.4	**10**	Hydrogeologic Report in Support of an Application for a Class B Conditional Pumpage Permit	Kyle No. 4 Well (5857916)	11/17/08	Edwards	30.028830	-97.878740	GEOS Consulting	Hays
Mustang (True) Ranch	**11**	Groundwater Availability Study of Mustang Ranch Subdivision	Mustang Ranch 54A (57638--)	6/24/08	Middle Trinity	30.030278	-98.026389	Wet Rock Groundwater Services, L.L.C	Hays
Synergy Ranch	**12**	Certification of Groundwater Availability For Platting & Supporting Hydrogeological Report: Synergy Ranch, Bastrop County, Texas	Synergy Ranch Lot 26; (58-62-705)	6/15/07	Wilcox (Upper; Calvert Bluff)	30.037500	-97.375000	GEOS Consulting	Bastrop
Monarch #4	**13**	Well Testing and Hydrogeologic Report - Monarch Utilities, Inc., Plum Creek Water System, Hays County, Texas	Monarch #4 Well (5858708)	7/23/07	Edwards	30.041666	-97.852777	Thornhill Group, Inc.	Hays
Plum Creek (Tecon) No. 3	**14**	Plum Creek Water System Well #3 Hydrogeologic Report	PCWS Well #3 (5858708)	9/14/03	Edwards	30.041666	-97.852777	Wet Rock Groundwater Services	Hays
Goforth No.5	**15**	Hydrogeologic Report in Support of a Pumpage Permit Application: Goforth W.S.C. No. 5 Well, Hays County, Texas	Goforth Well No. 5 (58584G5 58584GF)	10/19/00	Edwards	30.047778	-97.867778	GEOS Consulting	Hays
Centex Well 415	**16**	Geohydrologic Repot Centex	5858415	8/1/93	Edwards	30.051111	-97.859166	R.W. Harden & Associates, Inc.	Hays
Ruby Ranch No. 5	***17***	*Draft: Figures & Tables from: Hydrogeologic Report in support of an application for a pumpage permit volume amendmen*	*Well No. 5*	*7/18/10*	*Middle Trinity*	*30.058210*	*-97.920700*	*draft: Geos Consulting*	*Hays*
Ruby Ranch No. 4	**18**	Hydrogeologic Report in Support of a Pumpage Volume Amendment Application: TWC Enterprises/ Ruby Ranch, Hays County, Texas	58575TWC4 5857512	9/10/01	Edwards	30.058611	-97.921110	GEOS Consulting	Hays
Running Rope/Sierra West	**19**	Water Availability Investigation: Running Rope Estates (Sierra West Sec. 2A) Hays County, Texas	Sierra West No. 2 (58574RR1)	5/19/00	Middle Trinity	30.059722	-98.004444	GEOS Consulting	Hays
Penbur Well	**20**	Penbur Farms Water Well No. 1	Penbur Well No. 1 (5858410)	9/1/95	Edwards	30.065628	-97.843776	Wellspec Company	Hays
Centex	**21**	Hydrogeologic Study Report	5858414	12/1/03	Edwards	30.067777	-97.862777	RMT, Inc.	Hays
Centex Well 414	**21**	Geohydrologic Repot Centex	5858414	8/1/93	Edwards	30.067777	-97.862777	R.W. Harden & Associates, Inc.	Hays
Centex Well 414	**21**	Geohydrologic Report Centex	5858414	4/1/91	Edwards	30.067777	-97.862777	R.W. Harden & Associates, Inc.	Hays
Kelly's Country	**22**	Water Availability Study Kelly's Country A Proposed Subdivision in Hays County, Texas	Kelly's Country (57644KC)	10/1/04	Middle Trinity	30.068917	-98.092333	Banks & Associates, Erin K. Banks	Hays
Buda No. 3	**23**	Hydrogeologic Report in Support of a Pumpage Volume Amendment Application: City of Buda Hays County, Texas	Buda No. 3 (5858413)	8/9/01	Edwards	30.073056	-97.834722	GEOS Consulting	Hays
Running Rope	**24**	Water Availability Investigation Running Rope No.1 Testwell, Hays County, Texas	Running Rope Test well No. 1 (58-57-4R1)	12/8/99	Upper Trinity Aquifer	30.073333	-97.995236	Wellspec Company & Geos Consulting	Hays
Ruby Ranch No. 3	**25**	Hydrogeologic Report in Support of an Application for a Pumpage Permit Volume Amendmen	RRWSC No. 3 (58576M3)	8/18/07	Edwards	30.074166	-97.915833	GEOS Consulting	Hays
Plum Creek (Tecon) No. 1	**26**	Hydrogeologic Report in Support of a Pumpage Volume Amendment Application: Plum Creek Water Supply Corporation, Hays County, Texas	Plum Creek (Tecon) No. 1 (5858413)	5/5/00	Edwards	30.076667	-97.834444	GEOS Consulting	Hays

KEY:

nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 1: Detailed pumping test summary table.

	TESTED WELL AND PUMP TEST INFORMATION												
Abbreviated Name	**Pump Test Date**	**Pumping well depth (ft)**	**Open-hole or screened interval diameter (in)**	**Open-hole or screened interval (ft)**	**Reported Aquifer type: Confined (C), Unconfined (U), Semi-Confined (SC)**	**Reported or Estimated Aquifer Thickness (ft)**	**Pumping Rate, gallons per minute (gpm)**	**Static Water Level Depth (ft)**	**Maximum drawdown (ft)**	**Pumping Duration (hours)**	**Specific Capacity (gpm/ft)**	**Water Quality (TDS, mg/L or Conductivity uS/cm)**	**Pumping well comments**
Lantana Ridge	August 4-5, 2000	580	6.00	nd	SC	60	38	247.67	66	12	0.58	457 mg/L	
Bridlewood	March 5, 2003	1100	nd	1060-1100 slotted	C	100	28.9	297.84	0.75	24	38.50	2890 mg/L	
Bridlewood	January 5, 2003	310	nd	nd	U	nd	3	230.4	19	24	0.16	530 uS/cm	
Cielo	October 21-24, 2004	860	5.00	658-860 open	C	120	9	467.65	103.35	22.5	0.09	1713 mg/L	
Little Arkansas	November 10-12, 1999	239	4.50	screened nd	C	200	12	30	145	24.5	0.08	2472 mg/L	
Las Misiones	May 25-26, 2005	450	6.25	100-450 open	nd	400	61.2	nd	16	24	3.83	304 mg/L	
Hermosa	December 13, 2005	900	8.00	nd	C	85	3	357.3	235	24	0.01	677 mg/L	
River Mountain Ranch	May 21-27, 2001	1030	8.00	165-1030	U & C	865 e	105 to 98	308.3	72.2	31.8	1.40	2622 mg/L	After May 2001 800 ft well deepened to 1030; Specific Capacity 1.55 May and 1.4 July
Pinnacle Ridge	December 29, 2006	860	8.00	560-860	C	nd	14	380.2	35.7	24	0.39	1345 mg/L	
Kyle No.4	September 4-5, 1997	734.7	12.00	349-740	C	450	850	168.33	147	24	6.30	300 mg/L	Began pumping 920 and had to cut back to 850
Kyle No.4	September 23-26, 2008	734.7	12.00	349-740	C	450	920	218.9	99	56.6	9.30	570 uS/cm	
Mustang (True) Ranch	June 17, 2008	400	8.00	320-380 slotted	U	60	37.5	248.68	57.42	25.13	0.65	332 mg/L	well efficiency 50%
Synergy Ranch	December 17-19, 2005	210	8.00	155-195 slotted	nd	150	51	77	24.5	27.7	2.10	703 mg/L	
Monarch #4	June 10-15, 2007	800	8.00	455-645	C	450	400	150	468.49	120	0.85	460 mg/L	
Plum Creek (Tecon) No. 3	August 23-25, 2001	790	14.00	420-625 open	C	450	472	nd	267.32	24.4	1.77	435 mg/L	
Goforth No.5	June 4-6, 1999	750	14.00	430-750 open	C	450	328	142.7	63.8	24	5.14	503 mg/L	
Centex Well 415	August 25 to 26, 1993	540	10.00	127-540 perforated steel	C	350	1080	98.18	nd	8.75	nd		
Ruby Ranch No. 5	*February 2-5, 2 010*	*1140*	*7.88*	*1065-1140*	*C*	*72*	*254*	*203.6*	*201*	*69.25*	*1.26*	*1100 mg/L*	
Ruby Ranch No. 4	May 31- June 3, 2001	405	8.63	178-405 open	U	235	94	135.6	177	45	0.53	370 mg/L	
Running Rope/Sierra West	May 11-12, 2000	940	10.00	nd	C	70	237	nd	236.4	25	1.00	795 mg/L	
Penbur Well	June 20, 1995	740	12.00	480-740	C	450	92.4	136.25	89.44	24	1.05	470 mg/L	
Centex	November 15-16, 2003	797	12.00	376-797 open	C	475	811	147.55	84.74	36	9.57	585 uS/cm	well efficiency 17-27 %
Centex Well 414	August 18 to 19, 1993	797	12.00	376-797 open	C	350	860	139.8	116	9	9.40		
Centex Well 414	March 14, 1991	797	12.00	376-797 open	C	400	1285	126.88	21	4	63.50		
Kelly's Country	October 12-13, 2004	460	5.00	nd	C	135	12.5	327.02	41.73	24	0.30	612 mg/L	
Buda No. 3	No. 3 December 2000	740	15.00	480-790 open	C	450	260	148.5	106.8	48	2.43	575 to 760 uS/cm	390 decline to 260
Running Rope	October 11-13, 1999	460	6.00	40-460 open	C	nd	30	220	191	30	0.16	565 mg/L	
Ruby Ranch No. 3	February 27-March 4, 2007	400	10 e	nd	U	170	46	126.3	242	102	0.19	580 uS/cm	
Plum Creek (Tecon) No. 1	September 30- October 1, 1998	720	10.00	424 to 720 open	C	450	279	125.25	110	24	2.54		

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Appendix 1: Detailed pumping test summary table.

OBSERVATION WELL INFORMATION						
Abbreviated Name	**Obs well (yes or no)**	**Nearest Monitor well distance (ft)**	**Nearest Monitor well drawdown (ft)**	**Farthest Monitor well distance (ft)**	**Farthest Monitor well drawdown (ft)**	**Obs well comments**
Lantana Ridge	no	n/a	n/a	n/a	n/a	
Bridlewood	yes	238	0.5	n/a	n/a	estimated drawdown from plot
Bridlewood	no	n/a	n/a	n/a	n/a	
Cielo	yes	500	nd	n/a	n/a	inconclusive Observation well drawdown
Little Arkansas	yes	940	0	n/a	n/a	
Las Misiones	yes	350	1	n/a	n/a	distance estimated on map
Hermosa	yes	750	0	n/a	n/a	No measurable drawdown; distance estimated from map
River Mountain Ranch	yes	1200	71.7	n/a	n/a	
Pinnacle Ridge	yes	255	4.2	n/a	n/a	
Kyle No.4	yes	1000	24	7300	1.5	distance estimated on map
Kyle No.4	yes	900	18.7	4250	0.6	used pump test well with high degree of certainty
Mustang (True) Ranch	yes	1000	3.17	n/a	n/a	
Synergy Ranch	yes	750	1.83	n/a	n/a	
Monarch #4	yes	202	63	2076	3.2	
Plum Creek (Tecon) No. 3	yes	1300	6.98	1911	9.59	well farthest away experienced most drawdown
Goforth No.5	yes	1900	2.15	8100	0.5	distance estimated on map
Centex Well 415	yes	1200	2.45	8500	0.2	
Ruby Ranch No. 5	*yes*	*4990*	*5.8*	*9920*	*2.1*	
Ruby Ranch No. 4	yes	~3800	<0.1	~6000	<0.1	No measurable drawdown
Running Rope/Sierra West	yes	750	37.4	n/a	n/a	
Penbur Well	no	n/a	n/a	n/a	n/a	
Centex	yes	1160	3.48	8200	0.92	9 observation wells
Centex Well 414	yes	1450	2.62	7800	0.4	
Centex Well 414	yes	1200	1.64	1450	1.18	
Kelly's Country	yes	500	14.98	n/a	n/a	distance estimated on map
Buda No. 3	yes	2000	5.9	4000	2.8	distance estimated on map
Running Rope	yes	508	92	878	44	
Ruby Ranch No. 3	yes	1500	<0.3e	4500	0.2e	No (high confidence) measurable drawdown
Plum Creek (Tecon) No. 1	yes	50	9	~2900	<1.5	estimated on map

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Appendix 1: Detailed pumping test summary table.

	PUMPING TEST FINDINGS: HYDRAULIC PARAMETERS										
Abbreviated Name	**Average Transmissivity (gpd/ft)**	**Average Hydraulic Conductivity (*K*) (gpd/ft^2)**	**Average Hydraulic Conductivity (*K*) (ft/day)**	**Minimum Transmissivity (gpd/ft)**	**Maximum Transmissivity (gpd/ft)**	**Average Storativity**	**Average S Comment**	**Min. Storativity**	**Max. Storativity**	**Analytical Solution**	**Comment**
Lantana Ridge	600	10.00	1.34	509	1270	5.00E-03	e	nd	nd	Cooper-Jacob, Theis	
Bridlewood	6,600	66.00	8.84	6630	6690	1.00E-04	e	1.00E-04	nd	Copper Jacob	No raw data from aquifer test provided, only analytical results and plots
Bridlewood	97	nd	nd	nd	nd	nd		nd	nd	Copper Jacob, only one calculation	No raw data from aquifer test provided, only analytical results and plots
Cielo	225	1.88	0.25	71	299	1.00E-05	e	nd	nd	Cooper-Jacob, Theis	
Little Arkansas	87	0.43	0.06	28	144	5.00E-03	e	n/a	n/a	Cooper-Jacob, Theis	
Las Misiones	12,716	31.79	4.26	10666	14989	9.50E-04		nd	nd	Cooper-Jacob, Theis	
Hermosa	60	0.71	0.09	8	158	1.00E-05	e	nd	nd	Cooper-Jacob, Theis	
River Mountain Ranch	200	nd	nd	160	240	1.20E-05				Cooper-Jacob	
Pinnacle Ridge	380	nd	nd	246	626	1.00E-03		1.00E-03		Cooper-Jacob, Theis	
Kyle No.4	15,000	33.33	4.47	9900	18700	2.00E-04		1.50E-05	2.30E-04	Cooper-Jacob and Thesis, Distance Drawdown	
Kyle No.4	47,926	106.50	14.27	14200	187000	1.20E-03		1.30E-04	3.80E-03	Cooper-Jacob, Theis, Residual Drawdown, Distance Drawdown	
Mustang (True) Ranch	3,127	52.12	6.98	1309	3127	9.50E-06	e	nd	nd	Cooper-Jacob, Theis	
Synergy Ranch	7,500	50.00	6.70	3900	14100	3.00E-04	e	2.30E-04	3.70E-04	Cooper-Jacob, Theis	
Monarch #4	67,000	12.50	1.68	105000	2200	1.00E-04	e	0.0000204	2.63E-03	Cooper & Jacob various other methods	
Plum Creek (Tecon) No. 3	19,621	43.60	5.84	10921	23733	3.08E-04		7.70E-05	5.84E-04	Cooper-Jacob, Theis	
Goforth No.5	12,000	26.67	3.57	6100	33300	1.00E-03	e	9.40E-04	1.10E-03	Cooper-Jacob, Theis, Distance-Drawdown	
Centex Well 415	100,905	288.30	38.63	43200	169714	5.80E-04		1.00E-04	1.20E-03	Cooper-Jacob, Theis	
Ruby Ranch No. 5	*5,000*	69.44	*9.31*	*580.0*	*21,000.0*	*5.00E-05*		*4.00E-05*	*8.00E-05*	*Theis, Cooper-Jacob*	*Reported as "conservative nominal" values*
Ruby Ranch No. 4	250	1.06	0.14	244	580	1.00E-02	e	nd	nd	Cooper-Jacob, Theis	
Running Rope/Sierra West	2,800	40.00	5.36	2400	3650	2.50E-05	e	2.40E-05	4.50E-05	Cooper-Jacobs	
Penbur Well	1,284	2.85	0.38			nd		nd	nd	Drawdown Recovery Curves	
Centex	119,100	250.74	33.60	66640	306800	4.00E-04		2.40E-04	1.10E-03	Cooper-Jacob, Theis	geometric mean, storage values reflected unconfined values to west, confined values to east
Centex Well 414	155,340	443.83	59.47	58400	426300	4.32E-04		2.50E-04	9.60E-04	Cooper-Jacob, Theis	
Centex Well 414	231,000	575.00	77.05	n/a	n/a	n/a		1.00E-04	3.00E-04	Cooper-Jacob	
Kelly's Country	300	2.22	0.30	217	355	1.00E-05	e	1.86E-05	2.78E-05	Cooper-Jacob, Theis	
Buda No. 3	12,000	26.67	3.57	2400	26700	7.00E-04		2.00E-04	1.90E-03	Cooper-Jacob, Theis	
Running Rope	231	nd	nd	150	350	1.30E-05		0.000001*	1.00E-05	Cooper-Jacob and Horner Plot	Report omitted unrealistic parameters for max and min
Ruby Ranch No. 3	203	1.19	0.16	110	450	nd		nd	nd	Cooper-Jacob, Theis	
Plum Creek (Tecon) No. 1	15,000	33.33	4.47	22700	13900	5.00E-04	e	7.60E-04	n/a	Cooper-Jacob	

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Appendix 1: Detailed pumping test summary table.

GENERAL REPORT INFORMATION									
Abbreviated Name	**Map ID**	**Report Name**	**Well ID #**	**Date Report**	**Aquifer**	**Decimal Degrees Latitude**	**Decimal Degrees Longitude**	**Prepared by**	**County**
Goforth No.4	**27**	Hydrogeologic Report Goforth WSC: Wellfield	Goforth Well No. 4 (5858508)	3/25/97	Edwards	30.079166	-97.821943	Wellspec Company & GEOS Consulting	Hays
Ruby Ranch No. 1	**28**	Ruby Ranch No. 1 (no formal report)	58-57-608 (6TW)	2/7/97	Edwards	30.080278	-97.916667	BSEACD	Hays
Buda No. 1 & 2	**29**	Hydrogeologic Report in Support of an Application for a Pumpage Permit Volume Amendment	Buda No. 1 (5858403) & No. 2 (5858106)	11/10/04	Edwards	30.081667	-97.842500	GEOS Consulting	Hays
Buda No. 2	**30**	Hydrogeologic Report in Support of a Pumpage Volume Amendment Application: City of Buda Hays County, Texas	Buda No. 2 (5858106)	8/9/01	Edwards	30.084167	-97.841111	GEOS Consulting	Hays
High View	**31**	Water Availability Study High View Ranch Hays County, Texas	High View (57-64-1HE)	5/1/03	Middle Trinity	30.084603	-98.087189	Banks & Associates, Erin K. Banks	Hays
Riverwild	**32**	Groundwater Availability Report In Accordance with Hays Trinity Groundwater Conservation District Rules Operating Permit for a Public Water Supply Well Riverwild Subdivision, Driftwood, Texas	Riverwild PWS (TDLR # 93011)	6/1/08	Middle Trinity	30.087056	-97.991556	Bond Geological Services and Wellspec Company	Hays
Venado Ranch	**33**	Preliminary Water Availability Investigation El Venado Ranch, Blanco County, Texas	Irrigation Well	7/11/06	Middle Trinity	30.090194	-98.285306	Thw Wellspec Company	Blanco-Hays
Higginbotham Well	**34**	Well Testing and Hydrogeologic Report T.J. Higgenbotham Property Near Buda, Hays County, Texas	Higginbotham Well	9/7/00	Edwards	30.090556	-97.847778	Thornhill & Associates	Hays
Hunter	**35**	Geohydrological Report for Proposed Well Site I.H. 35 and Turnersville Road Hays County, Texas	5858220	11/20/89	Edwards	30.093333	-97.814444	Jack H. Holt & Associates Inc.	Hays
Creek Ridge, Bastrop	**36**	Hydrogeologic Report in Support of a Certification of Groundwater Availability: Creek Ridge Subdivision, Bastrop County, Texas	Creek Ridge Lot 1,2,3,4 (58-61-2--)	11/27/01	Simsboro (Carrizo-Wilcox)	30.096111	-97.428889	GEOS Consulting	Bastrop
Mt. Sharp	**37**	Water Availability Investigation: Mt. Sharp Ranch, Hays County, Texas	Mt. Sharp New Well	3/21/00	Lower Trinity	30.101111	-98.177500	GEOS Consulting	Hays
Mandola	**38**	Groundwater Availability Report in Accordance With Hays Trinity Groundwater Conservation District Rules Operating Permit for a Public Water Supply Well Mandola Estates, Driftwood, Texas	Mandola PW	3/1/08	Middle Trinity	30.103056	-98.013333	Bond Geological Services and Wellspec Company	Hays
Leisurewoods No. 6	**39**	Aquifer Pump Test Leisurewoods Water Company No. 6 Wellspec Project 242-01	Leisurewoods # 6 LR (5858108)	8/1/92	Edwards	30.105555	-97.862222	Wellspec Company	Hays
Oak Forest 2010	**40**	Hydrogeologic Report in Support of an Application for a pumpage permit volume amendment	No. 3	2/17/10	Middle Trinity	30.105994	-97.904153	Geos Consulting	Hays
Cimarron Well No. 2	**41**	Hydrogeologic Report Cimarron Well No. 2	Cimarron Well No. 2 (5858102)	4/1/97	Edwards	30.106666	-97.854444	Wellspec Company & GEOS Consulting	Hays
Porter No. 1	**42**	Hydrogeologic Investigation of the Porter Property, Northwest of Buda, Texas	Well No. 1 (5858123)	None Reported (1985e)	Edwards	30.109444	-97.841944	Dr. Albert E. Ogden	Hays
Huntington Estates No. 1	**43**	Hydrogeologic Report Huntington Estates Well No. 1	Huntington Estates Well No. 1 (5857308)	5/1/97	Edwards	30.110000	-97.878610	Wellspec Company & GEOS Consulting	Hays
Creedmoor-Maha Site 1	**44**	Hydrogeology Report in Support of a Pumpage Increase Application: Creedmoor-Maha Water Supply Corporation	Creedmoor-Maha Site 1 (5850847/6)	10/16/01	Edwards	30.115604	-97.895000	Collier Consulting, Inc.	Travis
Elliott Ranch No. 1	**45**	Hydrogeologic Report in Support of a Public Water Supply System Pumpage Permit Application: Elliot Ranch, Hays County, Texas	Elliott Ranch No. 1 (58573E3)	8/21/00	Edwards	30.115604	-97.895000	GEOS Consulting	Hays
Cimarron Well No. 3	**46**	Hydrogeologic Report Cimarron Park Well No. 3	Cimarron Well No. 3 (5858114)	9/1/01	Edwards	30.116111	-97.863055	Wellspec Company	Hays
Elliott Ranch No. 2	**47**	Hydrogeologic Report in Support of a Public Water Supply System Pumpage Permit Application: Elliot Ranch, Hays County, Texas	Elliott Ranch No. 2 (58573E4)	8/21/00	Edwards	30.116664	-97.893713	GEOS Consulting	Hays
Porter No. 2	**48**	Hydrogeologic Investigation of the Porter Property, Northwest of Buda, Texas	Well No. 2 (5858124)	None Reported (1985e)	Edwards	30.117499	-97.841110	Dr. Albert E. Ogden	Hays
Faith Dunn Ranches	**49**	Groundwater Availability for Platting Report Faith Ranch Hays County, Texas	Faith Dunn TW-1	9/27/05	Middle Trinity	30.121600	-98.098000	Daniel B. Stephens & Associates, Inc.	Hays
Oaks at Gatlin Creek	**50**	Groundwater Availability for Platting Report The Oaks at Gatlin Creek Hays County, Texas	TW-1	3/17/05	Middle Trinity	30.121600	-98.098000	Daniel B. Stephens & Associates, Inc.	Hays
Heatherwood	**51**	Water Availability Investigation Heatherwood Development Hays County, Texas	Heatherwood PW	4/1/04	Middle Trinity	30.122694	-98.077611	Wellspec Company and Bond Geological Services	Hays
Creedmoor-Maha Site 2	**52**	Hydrogeology Report in Support of a Pumpage Increase Application: Creedmoor-Maha Water Supply Corporation	Creedmoor-Maha Site 2 (5850849)	10/16/01	Edwards	30.130111	-97.821891	Collier Consulting, Inc.	Travis
Homestead at Gatlin Creek	**53**	Water Availability Study Homestead at Gatlin Creek Hays County, Texas	Homestead PW-1	6/1/03	Middle Trinity	30.131617	-98.139858	Banks & Associates, Erin K. Banks	Hays
Manchaca Optimist Club	**54**	Aquifer Test of Manchaca Optimist Sports Complex No. 1 in Support of an Operating Permit Application	MOYSC #1 Well No. 1 (58507MO)	2/20/04	Edwards	30.133438	-97.854310	Volunteers (TC&B)	Travis

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Appendix 1: Detailed pumping test summary table.

	TESTED WELL AND PUMP TEST INFORMATION												
Abbreviated Name	**Pump Test Date**	**Pumping well depth (ft)**	**Open-hole or screened interval diameter (in)**	**Open-hole or screened interval (ft)**	**Reported Aquifer type: Confined (C), Unconfined (U), Semi-Confined (SC)**	**Reported or Estimated Aquifer Thickness (ft)**	**Pumping Rate, gallons per minute (gpm)**	**Static Water Level Depth (ft)**	**Maximum drawdown (ft)**	**Pumping Duration (hours)**	**Specific Capacity (gpm/ft)**	**Water Quality (TDS, mg/L or Conductivity uS/cm)**	**Pumping well comments**
Goforth No.4	August 18, 1996	740	13.20	460-740 open	C	440	1350	170 e	101	10	19.30		
Ruby Ranch No. 1	January 31 - February 1, 1997	400	6.75	nd	U	270	42	nd	187	36	0.22		
Buda No. 1 & 2	July 1, 2004	390 (No. 1); 380 (No. 2)	10.00	222-390 open (No. 1); 195-380 open (No. 2)	C	450	670	85.8 (No. 1); 77.6 (No. 2)	16.7 (No. 1); 189 (No. 2)	72.9	2.04	575 uS/cm	Wells are about 1000 ft apart. First 3 hours No. 2 only pumped, then combined pumping (285 + 385 = 670)
Buda No. 2	No. 2 March 2001	380	18.00	195-380 open	C	450	315	61.4	170	48	1.85	540 to 590 uS/cm	
High View	April 24-25, 2003	567	5.00	nd	C	40	12	nd	22	24	0.55		
Riverwild	April 30, 2007 & May 2, 2007	660	8.00	640-660 slotted	C	100	275	201.6	38.4	24	7.20	669 mg/L	
Venado Ranch	June 29-30, 2006	451	5.00	nd	U	76	14	375.7	2.4	24	5.83	560 mg/L e	
Higginbotham Well	June 7-8, 2000	416	6.00	285-416	C	450	300	171.35	16	24	18.60	300 mg/L	3 ft cavity reported at 350-80 ft depth
Hunter	November 8, 1989	700	8.00	460-700	C	450	200	110	227	7	0.88		
Creek Ridge, Bastrop	November 14-16, 1999	260	nd	nd	nd	200	22	43.4	64.23	26.5	0.34	1160 mg/L	
Mt. Sharp	February 4-6, 2000	430	5.00	365-430 slotted	C	100	34	300	5.6	24.6	6.10	494 mg/L	
Mandola	August 20- 22, 2007	620	5.00	500-600 slotted	C	150	36	187	120	36	0.30	1020 mg/L	
Leisurewoods No. 6	July 28, 1992	548	10.75	215-550 open	C	330	450	215	0.4	4	112.50	265	
Oak Forest 2010	January 6-9, 2010	1190	7.88	1058-1190	C	135	115	245	124	24.4	0.93	1,240 mg/L	high sulfates 640mg/L
Cimarron Well No. 2	September 11-12, 1996	400	12.00	300-400	C	100	596	204.07	33	9	18.80		
Porter No. 1	February 20, 1985	520	8.00	230-510 open	U	450	400	97.7	48.6	24	8.20	400 uS/cm	No date on report; estimated date from date of well drilling
Huntington Estates No. 1	September 19-20,1996	405	6.00	255-405	C	175	104	nd	60.1	22.5	1.73		
Creedmoor-Maha Site 1	June 5-9, 2001	450	11.00	158-450 open	C	360	1200	12	80	96	15.00		two wells pump simultaneously
Elliott Ranch No. 1	December 4-5, 1999	405	10.00	250-403 torch-slotted	U	450	194	274	10.38	24	18.69	325 mg/L	
Cimarron Well No. 3	August 23-24, 2000	490	6.00	192-490 slotted	C	450	176	303.65	8.57	24	20.50		
Elliott Ranch No. 2	January 22-23, 2000	380	10.00	180-380 torch-slotted	U	450	205	258.4	10.4	24	19.71	332 mg/L	
Porter No. 2	February 20, 1985	510	8.00	200-510 open	U	450	350	132.3	23.7	24	14.60	480 uS/cm	No date on report; estimated date from date of well drilling
Faith Dunn Ranches	August 23, 2005	543	6.00	302-543 open	C	30	13	392.14	93	25	0.12	468 mg/L	well efficiency 40%
Oaks at Gatlin Creek	February 1, 2005	410	6.00	360-400 screen	nd	40	12.98	nd	10.96	28	1.18	343 mg/L	well efficiency 85%
Heatherwood	March 11-13, 2004	342	5.00	220-340	C	85	26	104.4	44.1	24	0.59	532 mg/L	
Creedmoor-Maha Site 2	June 10-14, 2001	493	10.75	217-493 open	C	360	1285	9.1e	nd	120	nd		
Homestead at Gatlin Creek	May 2, 2003	500	288-500 screen	360-400 screen	C	40	20.2	251.8	4.93	24	1.18	854 mg/L	
Manchaca Optimist Club	February 20, 2004	220	8 ?	100-120 open(e)	U	310	72	180	8.11	72	8.88		

KEY:
nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 1: Detailed pumping test summary table.

OBSERVATION WELL INFORMATION						
Abbreviated Name	**Obs well (yes or no)**	**Nearest Monitor well distance (ft)**	**Nearest Monitor well drawdown (ft)**	**Farthest Monitor well distance (ft)**	**Farthest Monitor well drawdown (ft)**	**Obs well comments**
Goforth No.4	yes	200	72	6200	<1	
Ruby Ranch No. 1	yes	500	2	n/a	n/a	
Buda No. 1 & 2	yes	400	44.6	2500	3.2	distance estimated on map
Buda No. 2	yes	~200	47.2	4000	1	distance estimated on map
High View	yes	900	4	n/a	n/a	
Riverwild	no	n/a	n/a	n/a	n/a	
Venado Ranch	no	nd	nd	nd	nd	
Higginbotham Well	yes	810	2.77	1650	1.97	
Hunter	yes	800	13	n/a	n/a	distance estimated on map
Creek Ridge, Bastrop	yes	125	12	400	8	subdivision pumping occurred in various wells
Mt. Sharp	yes	660	3.32	n/a	n/a	based on 1 year scenario
Mandola	yes	~1150	2	n/a	n/a	distance estimated on map
Leisurewoods No. 6	yes	500	0	nd	0	distance estimated on map
Oak Forest 2010	yes	7400	0	nd	nd	No observation well nearby
Cimarron Well No. 2	yes	1000	5.9	6000	1.71	estimated distance
Porter No. 1	yes	3750	2.6	n/a	n/a	
Huntington Estates No. 1	yes	1000	0.7	2500	0.28	distance estimated on map
Creedmoor-Maha Site 1	yes	~50	79	9700	2	twenty wells monitored
Elliott Ranch No. 1	yes	500	1.2	~2200	0.13	
Cimarron Well No. 3	yes	nd	nd	nd	nd	seven wells monitored, apparently no drawdown
Elliott Ranch No. 2	yes	500	1.2	2200	0.2	
Porter No. 2	yes	3750	nd	nd	nd	
Faith Dunn Ranches	yes	390	5	n/a	n/a	
Oaks at Gatlin Creek	yes	550	0.06	n/a	n/a	
Heatherwood	yes	320	7.6	n/a	n/a	distance estimated on map
Creedmoor-Maha Site 2	yes	~50	10.5	1000	1.5	twenty wells monitored
Homestead at Gatlin Creek	yes	537	6.29	n/a	n/a	
Manchaca Optimist Club	yes	250	0.27	n/a	n/a	only one well showed response

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Appendix 1: Detailed pumping test summary table.

	PUMPING TEST FINDINGS: HYDRAULIC PARAMETERS										
Abbreviated Name	**Average Transmissivity (gpd/ft)**	**Average Hydraulic Conductivity (*K*) (gpd/ft^2)**	**Average Hydraulic Conductivity (*K*) (ft/day)**	**Minimum Transmissivity (gpd/ft)**	**Maximum Transmissivity (gpd/ft)**	**Average Storativity**	**Average S Comment**	**Min. Storativity**	**Max. Storativity**	**Analytical Solution**	**Comment**
Goforth No.4	24,200	55.00	7.37			5.20E-03	e			Cooper-Jacob, Theis	
Ruby Ranch No. 1	273	1.01	0.14	137	402	nd		nd	nd	Cooper-Jacob, Theis	Nico Hauwert calculations; not a formal report
Buda No. 1 & 2	36,950	51.00	7.00	3000	94000	7.95E-04		2.00E-05	3.00E-03	Cooper-Jacob, Theis	
Buda No. 2	15,000	33.33	4.47	565	138600	1.00E-03		2.00E-05	8.10E-03	Cooper-Jacob, Theis	
High View	525	13.13	1.76	50	575	7.34E-05		nd	nd	Cooper-Jacob, Theis	
Riverwild	5,000	50.00	6.70	42850	2950	1.00E-03	e	nd	nd	Cooper-Jacob, Theis	
Venado Ranch	8,450	111.18	14.90	nd	nd	4.00E-02	e	nd	nd	Theis, Copper-Jacob	
Higginbotham Well	83,700	186.00	24.92	68400	9900	nd		nd	nd	Cooper-Jacob and Thesis	
Hunter	4,591	10.20	1.37	nd	nd	nd		nd	nd	Recovery	
Creek Ridge, Bastrop	750	3.75	0.50	620	1280	3.00E-04	e	1.60E-04	1.70E-03	Cooper-Jacob, Theis	
Mt. Sharp	4,000	40.00	5.36	2640	11220	7.00E-05		3.20E-05	1.10E-04	Cooper-Jacob, Theis	
Mandola	2,050	13.67	1.83	510	3870	1.00E-04	e	0.000001*	3.00E-04	Cooper-Jacob, Theis	
Leisurewoods No. 6	29,700	90.00	12.06	nd	nd	nd		nd	nd	Cooper- Jacob	
Oak Forest 2010	5,400	40.00	5.36	nd	nd	1.00E-03	e	nd	nd	Theis, Copper-Jacob	
Cimarron Well No. 2	14,000	140.00	18.76			0.06051*				Cooper-Jacob, Theis	
Porter No. 1	176,000	391.11	52.41	nd	nd	3.80E-03		nd	nd	estimated T from specific capacity (T = SC * 2000)	
Huntington Estates No. 1	7,885	45.06	6.04	nd	nd	nd		nd	nd	Cooper-Jacob, Theis	
Creedmoor-Maha Site 1	15,000	41.67	5.58			2.00E-03				Cooper-Jacob, Theis	
Elliott Ranch No. 1	34,300	76.22	10.21	25200	41600	1.00E-02		0.0036*	0.045*	Cooper-Jacob, Theis	
Cimarron Well No. 3	103,000	228.89	30.67	96900	622400	1.00E-03				Cooper-Jacob and Thesis	
Elliott Ranch No. 2	12,500	27.78	3.72	12000	13000	nd		nd	nd	Cooper-Jacob, Theis	
Porter No. 2	nd	nd	nd	nd	nd	nd		nd	nd	no calculation performed	
Faith Dunn Ranches	1,034	34.47	4.62	nd	nd	4.01E-05	e	nd	nd	Theis	
Oaks at Gatlin Creek	3,600	90.00	12.06	nd	nd	2.50E-04	e	nd	nd	Theis	
Heatherwood	2,000	23.53	3.15	1493	2068	4.00E-05	e	0.00000001*	4.00E-05	Cooper-Jacob, Theis	
Creedmoor-Maha Site 2	55,750	154.86	20.75			6.00E-04				Cooper-Jacob, Theis	
Homestead at Gatlin Creek	3,000	75.00	10.05	2287	3729	1.00E-05	e	nd	1.03E-05	Cooper-Jacob, Theis	
Manchaca Optimist Club	774,565	2,498.60	334.81	24761	130152	1.17E-04		0.000001375 *	1.375E-6*	Theis	

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Appendix 1: Detailed pumping test summary table.

GENERAL REPORT INFORMATION									
Abbreviated Name	**Map ID**	**Report Name**	**Well ID #**	**Date Report**	**Aquifer**	**Decimal Degrees Latitude**	**Decimal Degrees Longitude**	**Prepared by**	**County**
Onion Creek Golf No. 3	**55**	Geohydrological Report for Onion Creek Wells Manchaca, Texas	OC-3 (5850836)	7/15/91	Edwards	30.144999	-97.813055	Jack H. Holt & Associates Inc.	Travis
Onion Creek Golf No. 1 & 2	**56**	Geohydrological Report for Onion Creek Wells Manchaca, Texas	OC-1 (5850835) OC-2 (5850853)	7/15/91	Edwards	30.146388	-97.812500	Jack H. Holt & Associates Inc.	Travis
Shady Hollow Well No. 1	**57**	Results of Test Well Installation Shady Hollow Estates Water Supply System	Shady Hollow Estates Well No. 1 (5850731)	7/1/83	Edwards	30.149721	-97.860555	Underground Resource Management, Inc.	Travis
Shady Hollow Well No. 1	**57**	Hydrogeologic Report Shady Hollow Well No. 1	Shady Hollow Well No. 1 (5850731)	11/1/93	Edwards	30.149721	-97.860555	Wellspec Company	Travis
Brushy Top 2006	**58**	Groundwater Availability Study Ranches of Brushy Top Subdivision Blanco County, Texas	RBT 1A	2/21/06	Middle Trinity	30.152945	-98.396330	Bond Geological Services	Blanco
Shady Hollow Well No. 2	**59**	Installation and Pumping Tests: Shady Hollow Well No. 2	Shady Hollow Well No. 2 (5850743)	2/4/03	Edwards	30.154444	-97.858888	GEOS Consulting	Travis
Kennedy Ranch	**60**	Water Availability Investigation Kennedy's Ranch Subdivision Hays County, Texas	Kennedy Ranch	2/1/05	Middle Trinity	30.156333	-98.181694	Wellspec Company and Bond Geological Services	Hays
Brushy Top 2005	**61**	Ground Water Availability Assessment Brushy Top Ranch Subdivision	Brushy Top #3	9/11/05	Lower Trinity	30.162723	-98.415676	William Feathergail Wilson	Blanco
Brushy Top 2006	**62**	Groundwater Availability Study Ranches of Brushy Top Subdivision Blanco County, Texas	RBT 3A	2/21/06	Lower Trinity	30.162723	-98.415676	Bond Geological Services	Blanco
Chama Trace Pumping Well	**63**	Water Availability Investigation Chama Trace Subdivision Hays County, Texas	Chama Trace Pumping Well	6/1/06	Lower Trinity	30.173611	-98.039111	Wellspec Company and Bond Geological Services	Hays
Roger Hanks	**64**	Water Availability Investigation Roger Hanks Business Park Hays County, Texas	Roger Hanks Business Park Well No. 1 (5756480)	9/1/04	Lower Trinity	30.184166	-98.146110	Wellspec Company& Bond Geological Services	Hays
Dos Lagos	**65**	Water Availability Investigation Dos Lagos Subdivision Hays County, Texas	Dos Lagos PW-1 (5755604)	4/1/04	Middle Trinity	30.193610	-98.165555	Wellspec Company and Bond Geological Services	Hays
Valley Verde	**66**	Water Availability Investigation Valley Verde Subdivision Hays County, Texas	Valley Verde Test Well	9/20/00	Middle Trinity	30.196750	-98.216944	Wellspec Company & Bond Geological Services	Hays
Foster Ranch/Belterra	**67**	Test Well Drilling and Preliminary Groundwater Availability Study Mak Foster Ranch, L.P. Belterra/ Foster Ranch Hays County, Texas	Foster Ranch Well No. 1 (5849413)	4/12/02	Lower Trinity	30.198055	-97.980278	Wellspec Company & Bond Geological Services	Hays
Shady Valley	**68**	Water Availability Investigation Shady Valley Subdivision Units II, III, and IV, Hays County, Texas	PW 2&3 (PW-4)	9/12/02	Middle Trinity	30.202200	-98.219700	Wellspec Company and Bond Geological Services	Hays
Shady Valley	**68**	Water Availability Investigation Shady Valley Subdivision Unites II, III, and IV Hays County, Texas (Sierra West Sec. 2A)	PW 2&3; (57554PH1 & 2)	9/12/02	Middle Trinity	30.202222	-98.219722	Wellspec Company and Bond Geological Services	Hays
Shady Valley	**68**	Water Availability Investigation Shady Valley Subdivision Unites II, III, and IV Hays County, Texas (Sierra West Sec. 2A)	PW-4; (57551PH1)	9/12/02	Middle Trinity	30.202222	-98.219722	Wellspec Company and Bond Geological Services	Hays
Capital Soccer	**69**	Preliminary Hydrogeologic Report: Capital Soccer Club No. 1 Well	5850231	7/3/03	Edwards	30.206670	-97.791940	GEOS Consulting	Travis
Polo Club	**70**	Water Availability Investigation , The Polo Club, Hays County, Texas	PC-2	6/27/03	Lower Trinity	30.211000	-98.006833	Wellspec Company & Bond Geological Services	Hays
Independence Park	**71**	Hydrogeologic Report in Support of an Application for a Pumpage Permit: Independence Park Irrigation Well	Indp. Park (5850234)	9/21/07	Edwards	30.213056	-97.802500	GEOS Consulting	Hays

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Appendix 1: Detailed pumping test summary table.

	TESTED WELL AND PUMP TEST INFORMATION												
Abbreviated Name	**Pump Test Date**	**Pumping well depth (ft)**	**Open-hole or screened interval diameter (in)**	**Open-hole or screened interval (ft)**	**Reported Aquifer type: Confined (C), Unconfined (U), Semi-Confined (SC)**	**Reported or Estimated Aquifer Thickness (ft)**	**Pumping Rate, gallons per minute (gpm)**	**Static Water Level Depth (ft)**	**Maximum drawdown (ft)**	**Pumping Duration (hours)**	**Specific Capacity (gpm/ft)**	**Water Quality (TDS, mg/L or Conductivity uS/cm)**	**Pumping well comments**
Onion Creek Golf No. 3	April 30, 1991	500	8.00	222-500	C	450	118	54.5	101.11	48	1.17		80-130 gpm
Onion Creek Golf No. 1 & 2	May 7, 1991	490	8.63	220-490	C	450	202	54.23	191.02	48	1.06		average pumping value for combined wells
Shady Hollow Well No. 1	Proposal, no real data on Pump Test	438	8.63	193--433 slotted steel	U	350	210	185.05	10.09	24	21.00	310 mg/L	
Shady Hollow Well No. 1	September 1-2, 1993	302	8.63	193--433 slotted steel	U	315	200	191.12	7.49	32	26.20	280	
Brushy Top 2006	January 9 - February 11, 2006	465	4.5 e	380-465	U	80	12	244.3	78.8	24	0.15	3610 mg/L	1 of 8 well pairs conducted
Shady Hollow Well No. 2	August 21, 2002 and October 2-15, 2002	461	12.00	206-437 torch-slotted	U	290	380	nd	185	97	2.05	407 mg/L	multiple pumping attempts; estimated max drawdown
Kennedy Ranch	January 6-8, 2005	500	nd	500-520 slotted	nd	160	15	nd	11.55	24.7	1.30	1550 mg/L	
Brushy Top 2005	September 11, 2005	580	4.50	460-520	C	60	13.6	nd	91.98	2	0.15	1,850-2,200 mg/L	
Brushy Top 2006	January 9 - February 11, 2006	670	4.50	460-520	C	60	12	293.39	88.7	24	0.14	3660 mg/L	1 of 2 wells tests conducted; this well is same as 2005 study
Chama Trace Pumping Well	May 23-25, 2006	500	4.50	440-500 screen	C	100	30	210.51	34.2	24	0.88	1010 mg/L	
Roger Hanks	August 11-12, 2004	380	8.00	160-380 slotted	C	200	150	nd	9.28	24	16.16	3005 mg/L	back plugged from 420
Dos Lagos	March 17-19, 2004	460	4.50	20-460	C	80	75	nd	16.3	16.5	4.60	1720 mg/L	
Valley Verde	August 18-19 & 21-22, 2000	455	5.00	10-455 slotted?	C	100	30	317.3	5	24	6.00	2800 mg/L	Pump test occurred on Aug 18-19 and Aug 22-23 due to failed data logger
Foster Ranch/Belterra	March 13-15, 2002	903	7.88	636-903 open	C	290	95	408	143	120	0.75	810 mg/L	
Shady Valley	August 9-10, 2002	450	8.00	nd	U	25	40	254.7	2	24	20.00	3,000 mg/L	Two aquifer tests; high sulfates (>2,000 mg/L)
Shady Valley	August 9-10, 2002	450	5.00	nd	nd	25	40	254.7	1.97	24	20.30	3000 mg/L	
Shady Valley	August 7-8, 2002	430	5.00	nd	nd	25	30	226.12	2.04	24	14.71	3000 mg/L	
Capital Soccer	June 29-July 1, 2003	530	8.00	257-540 open	C	450	300	nd	nd	27.5	nd		
Polo Club	February 22-28, 2003	830	8.00	640-830	C	300	108	384.1	86	48	1.26	1381 mg/L	
Independence Park	July 10-12, 2007	442	6.50	342-442 slotted	U	450	48.5	180	29.7	42.5	1.60	455 mg/L	

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Appendix 1: Detailed pumping test summary table.

OBSERVATION WELL INFORMATION						
Abbreviated Name	**Obs well (yes or no)**	**Nearest Monitor well distance (ft)**	**Nearest Monitor well drawdown (ft)**	**Farthest Monitor well distance (ft)**	**Farthest Monitor well drawdown (ft)**	**Obs well comments**
Onion Creek Golf No. 3	yes	151	15	617	4	
Onion Creek Golf No. 1 & 2	yes	333	550	617	550	estimated from OC-3 distances
Shady Hollow Well No. 1	no	n/a	n/a	n/a	n/a	
Shady Hollow Well No. 1	yes	1000	<0.1	n/a	n/a	no change measured
Brushy Top 2006	yes	470	16.2	n/a	n/a	
Shady Hollow Well No. 2	yes	~1250	<0.1	~4250	0	No measurable drawdown
Kennedy Ranch	yes	740	1.65	n/a	n/a	
Brushy Top 2005	No	n/a	n/a	n/a	n/a	
Brushy Top 2006	no	n/a	n/a	n/a	n/a	Middle Trinity monitored but no measurable effect
Chama Trace Pumping Well	yes	300	10.9	n/a	n/a	distance estimated on map
Roger Hanks	no	n/a	n/a	n/a	n/a	
Dos Lagos	yes	~450	3.3	n/a	n/a	distance estimated on map
Valley Verde	yes	600	1.3	n/a	n/a	
Foster Ranch/Belterra	no	n/a	n/a	n/a	n/a	
Shady Valley	yes	600	1.85	n/a	n/a	
Shady Valley	yes	600	1.89	n/a	n/a	
Shady Valley	yes	nd	nd	n/a	n/a	
Capital Soccer	yes	2500	0.9	n/a	n/a	distance estimated on map
Polo Club	yes	PC-3: 1,200	9.9	PC-4: 3,069	5	Middle Trinity monitor well (PC-1) 1,200 ft from pumping well; no drawdown; heads about 80 feet higher than lower Trinity
Independence Park	yes	700	0.9	1850	<0.1	distance estimated on map

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Appendix 1: Detailed pumping test summary table.

	PUMPING TEST FINDINGS: HYDRAULIC PARAMETERS										
Abbreviated Name	**Average Transmissivity (gpd/ft)**	**Average Hydraulic Conductivity (*K*) (gpd/ft^2)**	**Average Hydraulic Conductivity (*K*) (ft/day)**	**Minimum Transmissivity (gpd/ft)**	**Maximum Transmissivity (gpd/ft)**	**Average Storativity**	**Average S Comment**	**Min. Storativity**	**Max. Storativity**	**Analytical Solution**	**Comment**
Onion Creek Golf No. 3	3,998	8.88	1.19	1354	7897	6.29E-05		1.90E-05	1.07E-04	Cooper-Jacob	
Onion Creek Golf No. 1 & 2	2,734	6.08	0.81	463	6565	nd		nd	nd	Cooper-Jacob	
Shady Hollow Well No. 1	nd	nd	nd	nd	nd	nd		nd	nd	no calculation performed	
Shady Hollow Well No. 1	586,666	1,862.43	249.57	nd	nd	nd		nd	nd	Cooper-Jacob, Theis	
Brushy Top 2006	390	4.88	0.65	100	600	1.00E-05		7.00E-07	1.00E-04		Parameters from 8 well pair tests
Shady Hollow Well No. 2	6,183	21.32	2.86	200	11400	nd		nd	nd	Cooper-Jacob, Theis	
Kennedy Ranch	2,250	14.06	1.88	1822	3897	1.30E-04	e	1.00E-05	2.00E-04	Cooper-Jacob, Theis, Neuman	
Brushy Top 2005	108	1.80	0.24	nd	nd	3.88E-05	e	nd	nd	Theis	It is not clear if observations wells were used.
Brushy Top 2006	180	3.00	0.40	nd	nd	4.00E-06	e	nd	nd		
Chama Trace Pumping Well	1,900	19.00	2.55	1500	2300	5.00E-05	e	5.00E-05	1.00E-04	Cooper-Jacobs and Theis	
Roger Hanks	10,000	50.00	6.70	8784	23000	5.00E-03	e	nd	nd	Theis	estimated storage coefficients from Driskill
Dos Lagos	12,000	150.00	20.10	9605	13950	3.00E-04	e	2.00E-04	3.00E-04	Cooper-Jacobs and Theis	
Valley Verde	2,192	21.92	2.94	1605	3000	8.00E-03		1.00E-04	2.00E-02	Cooper-Jacob, Theis	
Foster Ranch/Belterra	1,500	5.17	0.69	nd	nd	nd		nd	nd	estimated T from specific capacity (T = SC * 2000)	
Shady Valley	10,000	400.00	53.60	11140	15660	1.00E-03		1.00E-05	4.00E-03	Theis, Copper-Jacob	
Shady Valley	10,000	400.00	53.60	11140	15270	1.00E-04	e	nd	nd	Cooper-Jacob, Theis	
Shady Valley	10,000	400.00	53.60	11850	15660	1.00E-04	e	nd	nd	Cooper-Jacob, Theis	
Capital Soccer	80,000	177.78	23.82	79000	248000	2.00E-04	e	2.00E-04	3.00E-04	Cooper-Jacob plot	not a formal report
Polo Club	3,500	11.67	1.56	1400	7000	1.00E-04	e	4.00E-05	0.06*	Cooper-Jacob, Theis	
Independence Park	1,500	3.33	0.45	1300	3200	1.00E-01	e	0.0001*	1.50E-01	Cooper-Jacob, Theis	

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nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 1: Detailed pumping test summary table.

GENERAL REPORT INFORMATION									
Abbreviated Name	**Map ID**	**Report Name**	**Well ID #**	**Date Report**	**Aquifer**	**Decimal Degrees Latitude**	**Decimal Degrees Longitude**	**Prepared by**	**County**
Sunset Valley	**72**	Geohydrologic Report: City of Sunset Valley (informal)	Sunset Valley (5850215)	9/4/96	Edwards	30.227500	-97.810000	nd	Travis
Goldenview	**73**	Water Availability Study Goldenview Estates Dripping Springs, Hays County, Texas	Peerman Land Co. PW 1 (well 5)	5/1/01	Middle Trinity	30.228320	-98.097913	Banks & Associates	Hays
Freescale	**74**	Water Well Evaluation: Freescale--Oak Hill Facility, Austin, Texas	Well No. 2	7/1/04	Middle and Lower Trinity	30.236264	-97.869113	Geos Consulting	Travis
Freescale	**75**	Water Well Evaluation: Freescale--Oak Hill Facility, Austin, Texas	Well No. 1	7/1/04	Middle Trinity	30.236362	-97.869165	Geos Consulting	Travis
Walnut Springs	**76**	Hydrogeologic Report for The Preserve at Walnut Springs Blanco County, Texas	Walnut Springs 1-P (57532--)	10/27/03	Ellenburger-San Saba	30.245000	-98.486389	Marshall E. Jennings and Trent E. Jennings	Blanco
St. Andrews No. 3	**77**	DRAFT NOTES GEOS CONSULTING	Well No. 3	n/a	Middle Trinity	30.245364	-97.851324	draft: GEOS Consulting	Travis
St. Andrews No. 2	**78**	Aquifer Pumping Test of Irrigation Wells No. 1 & 2: St. Andrews Episcopal High School, Travis County, Texas	St. Andrews No. 2 (5850126)	6/10/01	Lower Trinity	30.245939	-97.850992	draft: GEOS Consulting	Travis
Carr Well (Robert Small)	**79**	Results of Survey on R.D. Carr Water Well, Edgecliff, Austin, TX	Carr Water (5851103)	8/1/61	Middle Trinity	30.249721	-97.736666	Jack R. Barnes	Travis
Fronterra	**80**	Water Availability Investigation Fronterra Subdivision Hays County, Texas	Fronterra PW	12/1/04	Lower Trinity	30.253639	-98.034556	Wellspec Company and Bond Geological Services	Hays
Deerfield Estates	**81**	Water Availability Investigation Deerfield Estates II Hays County, Texas	Deerfield Burrus #1 (57562RB1)	4/3/00	Middle Trinity	30.254166	-98.051666	Wellspec Company and Bond Geological Services	Hays
Westridge	**82**	Water Availability Investigation Westridge Subdivision Hays County, Texas	Westridge Subdivision	4/10/00	Middle Trinity	30.256011	-98.164131	Wellspec Company & Bond Geological Services	Hays
Heather Hills	**83**	Water Availability Investigation Heather Hills Subdivision Hays County, Texas	PW 1	3/26/01	Lower Trinity	30.260172	-98.107944	Wellspec Company & Bond Geological Services	Hays
Forrister Well	**84**	Water Well Evaluation 2502 Loop 360 South Austin, TX	Forrister (5842821)	4/1/82	Edwards	30.263055	-97.813888	Underground Resource Management, Inc.	Travis
Rudy's Bar-B-Q	**85**	Rudy's BBQ on S. Capitol of TX Hwy (pump test, but NO formal report)	Rudy's (5842825)	Informal report (June 1998)	Edwards	30.264166	-97.814444	Wellspec & GEOS Consulting	Travis
Driskill Hotel Well	**86**	TWDB Pumping Test Data: Driskill Hotel 5843703	Driskill (58-43-703)	10/15/64	Lower Trinity	30.268054	-97.739999	TWDB	Travis
Walking W Ranch	**87**	Water Availability Investigation Walking W Ranch Subdivision Hays County, Texas	Walking W (57487WR1)	4/12/03	Middle Trinity	30.288833	-98.096167	Wellspec Company and Bond Geological Services	Hays
Woodlands	**88**	Water Availability Investigation Woodlands Estates II Hays County, Texas	Woodlands (5740702)	5/5/00	Middle Trinity	30.144786	-97.995343	Wellspec Company and Bond Geological Services	Hays
EMS Well	**89**	Cottonwood Creek RV c/o Sherry Ems	EMS Well No.1 (57-55-7)	7/1/2005	Middle Trinity	30.161667	98.245000	GEOS Consulting	Hays

KEY:
nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 1: Detailed pumping test summary table.

	TESTED WELL AND PUMP TEST INFORMATION												
Abbreviated Name	**Pump Test Date**	**Pumping well depth (ft)**	**Open-hole or screened interval diameter (in)**	**Open-hole or screened interval (ft)**	**Reported Aquifer type: Confined (C), Unconfined (U), Semi-Confined (SC)**	**Reported or Estimated Aquifer Thickness (ft)**	**Pumping Rate, gallons per minute (gpm)**	**Static Water Level Depth (ft)**	**Maximum drawdown (ft)**	**Pumping Duration (hours)**	**Specific Capacity (gpm/ft)**	**Water Quality (TDS, mg/L or Conductivity uS/cm)**	**Pumping well comments**
Sunset Valley	May 14, 1997	360	6.63	122-360 open	U	280	150	219.07	49.57	7.5	3.03		
Goldenview	April 12-13, 2001	650	5.00	560-650 slotted	C	40	14	231.18	22.06	24	0.63	2100 mg/L	
Freescale	June 7-10, 2004	840	6.00	695-840	C	not reported	92	262.4	63.2	39.4	1.46	2710 mg/l	burlap packer separates Middle and Lower Trinity
Freescale	June 14, 2004	560	6.00	30-560	C	not reported	57	265.6	35.12	3.2	1.62	2260 mg/l	short duration
Walnut Springs	October 10-13, 2003	324	6.00	101-121, slotted 241-281 slotted	C	nd	20	186	4.43	24	4.50	600 mg/L	well blows air
St. Andrews No. 3	April 3, 2010	630	8.00	558-630	C	72	28	321.56	201.8	4.15	0.14	2300 uS/cm	average pumping value
St. Andrews No. 2	June 1, 2001	1000	6.00	nd	C	400 e	36	257.9	260	24	0.14	2400 uS/cm	
Carr Well (Robert Small)	July 27, 1961	1595	8.00	nd	C	nd	85	74 ft above LSD	67	5	1.20	1416 mg/L	flowing well
Fronterra	November 10-12, 2004	770	4.50	695-755 screen	C	200	11	509.98	20.2	24.15	0.54	1610 mg/L	
Deerfield Estates	March 11, 12, 2000	600	4.50	440-600 open	C	110	20	475.4	56.93	24	0.35	2600 mg/L	
Westridge	March 16-17, 2000	440	4.50	100-440 slotted	C	75	30	262.5	48.02	24	0.62	2500 mg/L	
Heather Hills	February 9-11, 2001	780	4.50	660-760 perforated	C	300	7.3	317.01	176.09	24	0.04	1600 mg/L	
Forrister Well	February 2, 1982	460	6.00	350-460 open	C	350-400	16	262.2	10.4	1.5	1.25	224 mg/L	
Rudy's Bar-B-Q	June 12-15, 1998	420	6.00	nd	C	360	40	244.07	76	36	0.53		
Driskill Hotel Well	October 15, 1964	2250	5.00	1580-2250 open	C	nd	19.6	70 ft above LSD	53.2	31.47	0.37	1520 mg/L	flowing well
Walking W Ranch	March 11-14, 2003	590	8.75	100-590 slotted	C	75	18.75	450.46	13.03	24	1.44	>2000 mg/L	
Woodlands	April 10-11, 2000	410	6.00	18-400 open	C	40	35	nd	1.36	24.01	25.74	2000 mg/L	
EMS Well	October 28-30, 2005	505	6.00	300-530 slotted	SC	200	15	331.65	9	24	1.67	1400 mg/l	

KEY:
nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 1: Detailed pumping test summary table.

OBSERVATION WELL INFORMATION						
Abbreviated Name	**Obs well (yes or no)**	**Nearest Monitor well distance (ft)**	**Nearest Monitor well drawdown (ft)**	**Farthest Monitor well distance (ft)**	**Farthest Monitor well drawdown (ft)**	**Obs well comments**
Sunset Valley	yes	nd	nd	n/a	n/a	No (high confidence) measurable drawdown
Goldenview	yes	463	0.42	n/a	n/a	distance estimated on map
Freescale	yes	50	37.1	1600	9.1	Drawdown is a composite value of Middle and Lower Trinity
Freescale	yes	50	9	n/a	n/a	
Walnut Springs	yes	592	1.8	n/a	n/a	
St. Andrews No. 3	yes	nd	nd	nd	nd	
St. Andrews No. 2	yes	200	20	n/a	n/a	
Carr Well (Robert Small)	no	n/a	n/a	n/a	n/a	
Fronterra	yes	660	3.3	n/a	n/a	
Deerfield Estates	yes	120	44.38	n/a	n/a	
Westridge	yes	400	0.44	n/a	n/a	
Heather Hills	yes	~625	11.19	n/a	n/a	distance estimated on map
Forrister Well	no	n/a	n/a	n/a	n/a	
Rudy's Bar-B-Q	yes	nd	nd	n/a	n/a	
Driskill Hotel Well	no	n/a	n/a	n/a	n/a	
Walking W Ranch	yes	620	2.7	n/a	n/a	
Woodlands	yes	800	0.2	n/a	n/a	
EMS Well	no	n/a	n/a	n/a	n/a	

KEY:
nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 1: Detailed pumping test summary table.

	PUMPING TEST FINDINGS: HYDRAULIC PARAMETERS										
Abbreviated Name	**Average Transmissivity (gpd/ft)**	**Average Hydraulic Conductivity (*K*) (gpd/ft^2)**	**Average Hydraulic Conductivity (*K*) (ft/day)**	**Minimum Transmissivity (gpd/ft)**	**Maximum Transmissivity (gpd/ft)**	**Average Storativity**	**Average S Comment**	**Min. Storativity**	**Max. Storativity**	**Analytical Solution**	**Comment**
Sunset Valley	6,557	23.42	3.14	5719	7565	nd		nd	nd	Cooper-Jacob, Theis	Nico Hauwert calculations; not a formal report
Goldenview	972	24.30	3.26	164	13203	5.00E-03	e	1.04E-03	n/a	Cooper-Jacob, Theis	972 Transmissivity used in availability calculations; Total drawdown in pumping well is unclear; higher values of drawdowns (76 ft) not explained in report but possibly interference, note page 4-1 is missing
Freescale	1,200	nd	nd	nd	nd	1.00E-03	e	nd	nd	Theis, Copper-Jacob	Reported as "conservative nominal" values
Freescale	1,600					2.00E-03				Theis, Copper-Jacob	Reported as "conservative nominal" values
Walnut Springs	3	nd	nd	1	5	9.00E-05	e	9.09E-05	6.80E-05	Cooper-Jacob, Theis	
St. Andrews No. 3	310	4.31	0.58	nd	nd	nd	nd	nd	nd	Cooper-Jacob	
St. Andrews No. 2	500	nd	nd	90	940	1.00E-03	e	2.30E-04	2.20E-03	Cooper-Jacob, Theis	draft report, tested 2 wells
Carr Well (Robert Small)	2,870	nd	nd	nd	nd	nd	see comment	nd	nd	Theis	estimated 1.85E-06 specific storage value reported; multiplied by aquifer thickness to get S
Fronterra	2,000	10.00	1.34	1200	3700	1.00E-03	e	4.00E-04	2.00E-04	Cooper-Jacob, Theis	
Deerfield Estates	250	2.27	0.30	181	475	1.00E-03	e	4.00E-04	0.0002	Theis, Neuman	
Westridge	1,336	17.81	2.39	610	2014	1.50E-02		3.00E-04	0.05*	Theis	
Heather Hills	100	0.33	0.04	69	206	3.00E-04		1.00E-05	1.00E-03	Theis	
Forrister Well	1,030	nd	nd	nd	nd	nd		nd	nd	nd	
Rudy's Bar-B-Q	1,149	3.19	0.43	82	5280	nd		nd	nd	Honer Plot and Cooper-Jacob, Theis	not a formal repot
Driskill Hotel Well	569	nd	nd	562	575	nd		nd	nd	Cooper-Jacob plot	no formal report
Walking W Ranch	2,300	30.67	4.11	2705	1948	5.00E-05		2.00E-05	5.00E-05	Cooper-Jacob, Theis	
Woodlands	9,600	240.00	32.16	4945	12000	3.40E-02	e	1.32E-04	1.00E-01	Cooper-Jacob, Theis	
EMS Well	1,020	5.10		600	1800	nd		nd	nd	Cooper-Jacob, Theis	no formal report

KEY:
nd = no data; e = estimated; * = out of expected range; n/a = not applicable; ~ = approximately

Appendix 2

Excerpt from TWDB Contract Report 2005-483-554: Tests from County Availability Studies, May 4, 2006

Aquifer Tests from County Availability Studies

Prepared for **Texas Water Development Board**

May 4, 2006

TWDB Contract

 # 2005-483-554

Daniel B. Stephens & Associates, Inc.

4030 W. Braker Lane, Suite 325 , Austin,Texas 78759

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1. Introduction and Purpose

Aquifer parameters obtained from pumping tests, such as transmissivity, storativity, hydraulic conductivity, specific capacity and ambient water levels is lacking in many parts of Texas. The groundwater availability models (GAMs), as well as other groundwater studies in Texas, rely on available aquifer test data to estimate groundwater availability and overall aquifer conditions. In 1999, the 76th Legislature passed Senate Bill 1323 instructing the Texas Natural Resource Conservation Commission (TNRCC), now the Texas Commission of Environmental Quality (TCEQ), to develop rules to guide licensed engineers and geologists on how to conduct Groundwater Availability Studies (GwAS) involving pump tests. Senate Bill 1323 provides cities and counties with the authority to withhold approval of subdivision plats until the developer obtains a certificate indicating that sufficient groundwater exists beneath the property being developed to meet anticipated demand for up to 30 years. Although a municipality or county is not required to exercise this authority, if it does, it must follow the requirements outlined in TCEQ Chapter 230.1 thru 230.11. This purpose of this project was to identify the political entities that require GwAS, and to compile the available aquifer test data from such entities and evaluate the GwAS reports.

The aquifer parameters generated during GwAS studies could be utilized during the development of GAMs and during other groundwater studies and improving the accuracy and reliability of local long-term groundwater resource management. Also, after a representative geographic distribution of GwAS reports have been completed for a county, the local county government and/or groundwater conservation district (GCD) may use this data to provide a geographic guide for identifying areas with higher sustainable well yields for future municipal well development or subdivision locations, or to provide information to drillers and residents in accessing local groundwater well yields. The cost of a pump test for a GwAS report is substantial for the subdivision owner, and the Texas Water Development Board (TWDB) will realize a significant benefit, at a minimal direct cost, in extracting pump test data from these GwAS reports.

The remainder of this report is organized according to the proposed project tasks outlined in DBS&A's proposal; the project tasks are listed below:

Task 1 Identify those counties that require a GwAS as part of their planning process.

Task 2 Determine which GwAS protocols are followed and obtain copies of all county-developed protocols.

Task 3 Obtain copies of GwAS reports done to date.

Task 4 Review the data for possible use in broader studies.

Task 5 Develop a database of the reports and their key content and data.

Task 6 Recommend a procedure for copies (hard and/or electronic) of the reports and raw data to be forwarded from the counties to the TWDB.

Task 7 Prepare final report

2. Results

This section presents the results of each of the primary project tasks. The majority of the project results, however, are provided in the project database and copies of the supporting materials.

2.1 Identification of Counties That Require a GwAS for Planning

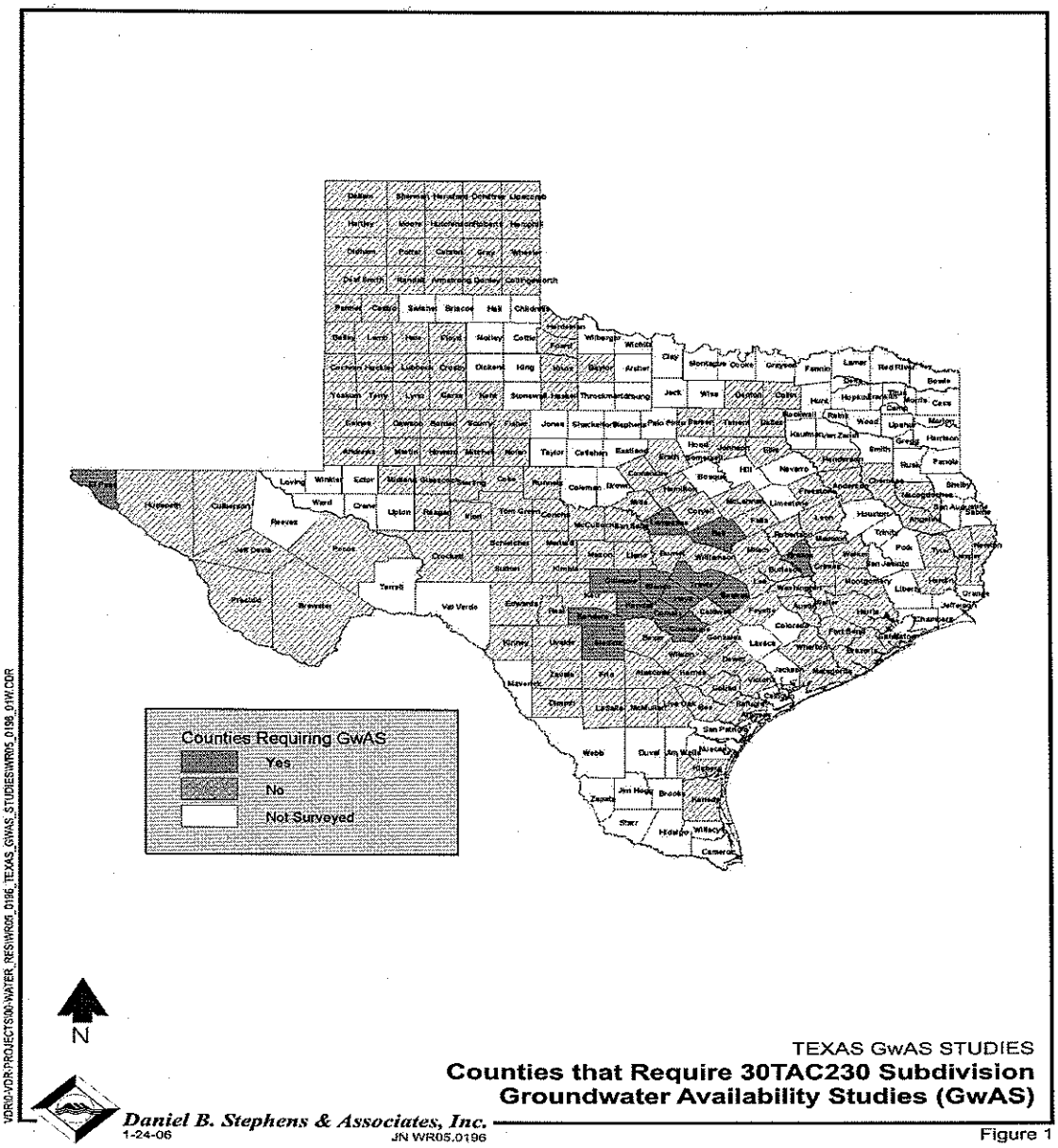
The first task of this project was to attempt to identify which of the 254 counties in Texas that require a GwAS as part of their subdivision platting process. During the kickoff meeting with the TWDB staff (to obtain the TWDB's copies of GwAS reports); the staff was questioned concerning the known counties requiring GwAS. In addition, an internet search was conducted to identify counties with subdivision rules requiring GwAS's, eight perspective counties were identified using the internet. The proposed approach was to obtain county platting authority contact information (e.g., email addresses, website addresses and phone numbers) through county organizations such as the Texas Association of Counties (TAC), County Information Project (CIP), County Information Resources Agency (CIRA), and Texas Association of County Engineers and Road Administrators (TACERA). Unfortunately, most of these organizations would either not relinquish their database of contact information (TACERA), or their databases were very incomplete and/or did not contain the desired information (CIP and CIRA).

The TAC website did, however, provide a list of state organizations that included the County Judges and Commissioners Association of Texas. Our early surveys revealed that very few of the counties have full time engineers and that the county judges and/or commissioners were usually the most informed representatives of their respective county. Internet searches of the Texas judges and commissioners association webpage provided a list of regional officers. An email describing the purpose of the request (GwAS studies, SB 1323) were forwarded to regional presidents and vice presidents throughout Texas. In addition, an email was developed for distribution to all of the groundwater conservation district (GCD) managers, since they are often consulted by county representatives and/or recipients of GwAS reports. Examples of a few of these emails are included in Appendix A. In addition to the emails, phone surveys were

also initiated during August, 2005.

Responses received after repeated emails were few; responses were received for judges in 3 counties and about 12 GCD managers. A decision was made in mid-October to abandon the email approach and to begin a focused calling effort to the remaining GCD managers and county judges and/or commissioners. County clerks were often contacted if contact information was not available for the judges or commissioners. The phone surveys were conducted until early November, 2005 when a meeting was held with the TWDB project managers (Dr. Robert Mace, Rima Petrossian, Brent Christian) to discuss the progress of Task 1. In consideration of time and level-of-effort constraints, an agreement was established concerning the number of remaining counties to be surveyed. Major urban areas that were the most likely to have implemented SB 1323 were surveyed. The tabulated results of phone and/or email surveys are in Appendix B.

A total of 154 counties were surveyed and the final results of the survey are illustrated in Figure 1. A total of 14 counties were identified that are actively requiring groundwater studies under 30TAC230 (Figure 1). Three additional counties (Burnet, Caldwell and Tom Green) implemented a county requirement for GwASs, but local resistance and politics subsequently caused these counties to repeal or abandon the GwAS requirement.



No counties were identified that used a county modified version of 30TAC230 GwAS. The counties that were not surveyed are predominantly rural with minimal potential for subdivision development.

2.2 Determination of GwAS Protocols

This task involved the determination of the GwAS protocols which are followed by the counties (county developed or 30TAC230) and collection of copies of all county-developed protocols (Task 2). Upon identifying counties that require GwAS, the county representative, consultant or local groundwater district manager was contacted to obtain copies of the county's subdivision requirements. As stated above, negotiations with counties known to require a GwAS in the platting process began upon the initiation of this project. Table 1 is a summary of the number of subdivisions GwAS reports collected for each county in this study and the counties that require GwAS in the subdivision platting process (30TAC230 or county subdivision rules).

Table 1. Counties requiring GwAS for subdivision platting and subdivisions with GwAS reports collected in this study

County	Subdivisions reports in this study	Implements 30TAC230?
Bandera	8	Yes
Bell	4	Yes
Blanco	8	Yes
Bastrop	0	Yes
Brazos	0	Yes
Comal	2	Yes
El Paso	0	Yes
Gillespie	4	Yes
Guadalupe	1	Yes
Hays	20	Yes
Kendall	3	Yes
Lampasas	0	Yes
Medina	0	Yes
Travis	1	Yes

A total of 14 counties (Table 1) require GwAS for the subdivision platting process. No cities were identified during the survey that required GwAS for subdivision platting. Hard copies of all

subdivision requirements for the counties are provided in Appendix C; six counties actively post their subdivision regulations on the internet at the addresses provided below.

Comal County Subdivision Rules - http://www.cceo.org/

Bandera County Subdivision Rules - http://www.banderacounty.org/documents/Bandera%20Counrty%20Subdivision%20Regulations.pdf

Hays County Subdivision Rules - http://www.co.hays.tx.us/departments/envirohealth/pdf/sub.pdf

Kendall County Subdivision Rules - http://www.co.kendall.tx.us/RulesPlans/DevelopmentRules2005.doc

Gillespie County Subdivision Rules - http://www.gillespiecounty.org/subdivision_regs.pdf

Travis County Subdivision Rules - http://www.co.travis.tx.us/tnr/subdivision/82_050729/Final_Plat_Review_Form.pdf

2.3 GwAS Reports Completed to Date

A total of 54 GwAS reports completed by consultants were obtained from either the TWDB, or county courthouses, GCDs or consultants (project Task 3). Some of these reports included more than one pump test for a subdivision, and therefore the reports include a total of 68 pump tests. Hard copies of all consultant reports have been provided to the TWDB. The report number listed in Appendix D is the index number for the hard copy reports. If multiple pump tests were conducted within a subdivision, the index number for the additional pump test will have a decimal designation (e.g., 3.1).

2.4 Review GwAS Data for Possible Use in Broader Studies

A total of 54 consultant reports and/or pump test analyses were reviewed and evaluated

(Task 4). Four of the reports obtained were from the TWDB and/or consultants included counties that do not require GwAS. These counties are Johnson (one report, no pump test), Kerr (two reports and pump tests) and Kinney (one report and pump test). Five counties (Bastrop, Brazos, El Paso, Lampasas and Medina) that require GwAS for subdivision plats either have had no subdivision activity requiring GwAS reports (used existing water suppliers) or the county representatives were unable to locate copies of the reports. Travis County initiated the GwAS requirement for subdivisions in August of 2005.

The following data was extracted from the GwAS reports for inclusion in this report:

1. Subdivision information, the name of the consultant that conducted the pump test, and the date of each pump test

2. Aquifer name, aquifer type (confined, unconfined), aquifer thickness, and well completion information (partially or fully penetrating well)

3. Geographic coordinates or state well grid for the test wells

4. Pumping well construction data (well depth, screen interval and diameter)

5. Pump test data (pump rate, duration of test, initial and final water levels, distance from pumping well to monitor wells)

6. Pump test analysis results (T, S, K) and specific capacity and well efficiency, if provided in the report

7. Future drawdown estimated by the consultant and recommended well spacing

8. Water chemistry (total hardness, Ca, Mg, Na, SO_4, Cl, F, TDS and pH) when available.

9. Consultant and DBS&A comments and DBS&A's subjective estimation of GwAS report reliability

A summary of the GwAS subdivision pump tests collected during this study are in a spreadsheet format in Appendix D. All the data entered in this spreadsheet has been through a quality assurance procedure and has been reviewed and verified from the source report. Transmissivity (T) and hydraulic conductivity (K) values from the reports were of the pumping wells and were converted to the standardized requested units of gallons per day per foot (gpd/ft) and gallons per day per foot squared (gpd/ft^2), respectively. Latitude and longitude GPS coordinates were converted to decimal degrees for easy integration into a GIS database. An electronic copy of Appendix D is included on the compact disc provided with this report.

Appendix D includes an estimated reliability of each report based on the subjective ranking of five variables, each worth one point. These variables, and the numeric scoring approach, are as follows:

1. Were latitude and longitude coordinates included in the report? (1=yes, 0=no)

2. Were screen intervals, aquifer characteristics (e.g., thickness) and water quality information included in the report? (1=yes, 0=no),

3. Was the pump test conducted for a time frame longer than 12 hours with drawdown curves suitable for analysis? (1=yes, 0=no)

4. Did the pump test include a monitor well? (1=yes, 0=no)

5. Was the pump test conducted in favorable weather and/or hydrogeologic conditions (e.g. unfavorable conditions would be during intense rainfall events, near faults or significant sources of recharge)? (1=yes, 0=no).

The maximum possible reliability score is 5, and the lowest possible score is 0. Reports with scores below and not including 3 in Appendix D are considered to have questionable reliability.

Most of the available GwAS reports are clustered in Hays, Bandera and Blanco counties. This is because (1) there is a lot of subdivision activity in these three counties, and (2) these counties

are actively maintaining and inventorying GwAS reports, and the reports are usually distributed to the respective local GCD.

Other counties either do not have a designated county engineer or staff member that coordinates the organization of these reports in the county courthouse, or the county does not keep or turn a copy over to the local GCD, or they are unable to locate the reports completed. The consultants that developed the reports are probably the best source for obtaining these "missing" reports. These reports are in the public domain and should be accessible by the state.

2.5 Database Development

The data obtained from the GwAS reports was compiled in Microsoft Excel spreadsheets, and was then converted to an Access database (Task 5). An electronic copy of the GwAS Access Database is included on the CD provided with this report.

2.6 Recommended Procedure for Transfer of GwAS Reports to the TWDB

As part of the project, DBS&A was also requested to recommend a procedure for transferring copies of GwAS reports (either hard copy or electronic) and associated raw data from the counties to the TWDB (Task 6). Present legislation should be amended to require that the local county clerk be responsible to mail a hard copy of each new GwAS report to the TWDB (Groundwater Technical Assistance Office) office within 90 days of completion.

The remainder of this section outlines a proposed procedure for electronic transferal of key GwAS report information from the counties to the TWDB water information integration and dissemination identification (WIID) database.

Each county collecting GwAS studies would obtain a unique data entry only access code from the TWDB to only enter GwAS data into a formatted data entry form created to interface with the TWDB's WIID website. The formatting of this form should be similar to the standardized 30 TAC 230.3 form used by most counties to minimize confusion during data entry. This data entry

form would include GwAS well pump test and aquifer attributes as well as other attributes determined by TWDB staff. Within this entry form, assigned cells would have to be automated to convert latitude, longitude, transmissivity and hydraulic conductivity to standardized units. Once completed and submitted by the county representative, this formatted GwAS data entry form would be temporarily stored on a hard drive until an authorized TWDB staff member has reviewed and approved the GwAS form for integration into the WIID system.

These GwAS wells with pump test data once within the WIID map system could then be easily filtered in the map interface by a specific button or color or by the standard query interface. Additionally, the GwAS wells could be flagged with appropriate code for referral to continuing attribute tables. Expanded attributes might include formation tops picked from electric logs referenced to sea level, interval thicknesses, type and quality of production test or even a plat map or log served up as an Acrobat PDF file.

Advantages of using the WIID structure are that the database and user interface already exist, and the expanded data can be managed by TWDB.

3. Recommendations

There are a number of observations and recommendations for implementing this type of study in the future. In retrospect, the level of effort required to contact informed individuals in the 254 counties in Texas who knew their county's status concerning the implementation of SB1323 and GwAS was significantly underestimated. Bulk emails to county engineers, judges and commissioners yielded very little response, probably the result of pervasive spam emails. By far, the most effective use of time was placing phone calls to the GCD managers, who were generally the most informed regarding groundwater studies and activities within their GCD. Most county governments do not have groundwater expertise on their staff, and they usually communicated with the GCD managers for advice on the GwAS information and the interpretation of pump test results. Large areas of Texas, however, are not included within the boundaries of GCDs. Since the implementation of GwAS studies by a county is usually prompted by rapid growth within the county resulting in new subdivisions, rural counties showing limited growth according to the most recent population census can probably be safely excluded from similar studies in the future.

Secondly, during this study, we compiled a list of about a half a dozen consultants that are probably completing about 80 percent or more of the GwAS reports. Since these studies are completed to meet county subdivision requirements, these GwAS reports should be in the public domain. We contacted most of these consultants during this project, and a few of them were reluctant to provide their reports to another consultant. TWDB staff would probably be more successful than a private consultant in gathering GwAS reports from private firms. A few GCDs (Hays, Blanco and Bandera counties) had excellent records and the consultant's GwAS reports were readily available. The remaining counties requiring GwAS struggled to find one or two reports in a timely manner.

Finally, this project is worth the effort for the additional hydrogeologic information obtained. The TWDB should consider updating this effort on a five year cycle, and incorporate the additional information into WIID.

STATE OF TEXAS

COUNTY OF BASTROP

BASTROP COUNTY
ORDER
Amendment to Subdivision Rules and Regulations

Standards for Determining Groundwater Availability for New Subdivisions

WHEREAS, The Legislature has enacted legislation amending Subchapter A, Chapter 232, Local Government Code, by adding Section 232.0031, "Additional Requirements: Use of Groundwater," enabling Commissioners Courts to adopt regulations requiring certification that adequate groundwater is available for the subdivision of a tract of land for which the source of the water supply intended for the subdivision is groundwater under that land; and

WHEREAS, the Commissioners Court of Bastrop County, Texas deems it appropriate to exercise its authority by enacting this Order requiring that a plat application have attached to it a statement that:

(1) is prepared by an engineer registered to practice in this state; and
(2) certifies that adequate groundwater is available for the subdivision; and

WHEREAS, the Texas Natural Resource Conservation Commission has established the form and content of the certification as adopted in Title 30, Texas Administrative Code, Chapter 230; and

WHEREAS, the form and Chapter 230 rules do not replace state requirements applicable to public drinking water supply systems or the authority of counties or groundwater conservation districts under either Subchapter 35.019 or Chapter 36 of the Texas Water Code; and

WHEREAS, no person shall drill an exempt water well before filing an application for a drilling registration and receiving the registration or drill a non-exempt water well before filing an application for a drilling permit and receiving the drilling permit from the Lost Pines Groundwater Conservation District as authorized under Senate Bill 1911 (Acts 1999, 76th Legis.).

THEREFORE, BE IT HEREBY RESOLVED that the above amendment of the Bastrop County Subdivision Regulations shall be published and incorporated in said Regulations by virtue of this Order.

AND IT IS SO ORDERED:

PASSED AND APPROVED THIS 9th DAY OF November, 2001.

APPROVED:

Ronnie McDonald
Bastrop County Judge

ATTEST:

Shirley Wilhelm
Bastrop County Clerk

Approved as to form:

Charles D. Penick
Bastrop County District Attorney

FIGURE 30 TAC §230.3(c)
CERTIFICATION OF GROUNDWATER AVAILABILITY FOR PLATTING FORM

Use of this form: If required by a municipal authority pursuant to §212.0101, Local Government Code or a county authority pursuant to §232.0031, Local Government Code, the plat applicant and the Texas licensed professional engineer shall use this form based upon the requirements of Title 30, Texas Administrative Code, Chapter 230 to certify that adequate groundwater is available under the land to be subdivided (if the source of water for the subdivision is groundwater under the subdivision) for any subdivision subject to platting under §§212.004 and 232.001, Local Government Code. The form and Chapter 230 do not replace state requirements applicable to public drinking water supply systems or the authority of counties or groundwater conservation districts under either §35.019 or Chapter 36 of the Texas Water Code.

Administrative Information (30 TAC, §230.4).

1. Name of Proposed Subdivision:_____
2. Any Previous Name Which Identifies the Tract of Land:_____
3. Property Owner's Name(s):_____
   - Address:_____
   - Phone:_____
   - Fax:_____
4. Plat Applicant's Name:_____
   - Address:_____
   - Phone:_____
   - Fax:_____
5. Licensed Professional Engineer's Name:_____
   - Address:_____
   - Phone:_____
   - Fax:_____
   - Certificate Number:_____
6. Location and Property Description of Proposed Subdivision:_____
7. Tax Assessor Parcel Number(s).
   - Book:_____
   - Map:_____
   - Parcel:_____

Proposed Subdivision Information (30 TAC, §230.5).

8. Purpose of Proposed Subdivision (single family/multi-family residential, non-residential, commercial):_____
9. Size of Proposed Subdivision (acres):_____
10. Number of Proposed Lots:_____
11. Average Size of Proposed Lots (acres):_____
12. Anticipated Method of Water Distribution.

Expansion of Existing Public Water Supply System:	Yes	No
New (Proposed) Public Water Supply System:	Yes	No
Individual Water Wells to Serve Individual Lots:	Yes	No
Combination of Methods:	Yes	No

   Description (if needed):_____
13. Additional Information (if required by the municipal or county authority):_____

Note: If public water supply system is anticipated, written application for service to existing water providers within a ½-mile radius should be attached to this form [30 TAC, §230.5(f)].

Projected Water Demand Estimate (30 TAC, §230.6).

14. Residential Water Demand Estimate at Full Build Out (includes both single family and multi-family residential).
    - Number of Proposed Housing Units (single and multi-family):_____
    - Average Number of Persons per Housing Unit:_____
    - Gallons of Water Required per Person per Day:_____
    - Water Demand per Housing Unit per year (acre feet/year):_____
    - Total Expected Residential Water Demand per Year (acre feet/year):_____
15. Non-residential Water Demand Estimate at Full Build Out.
    - Type(s) of Non-residential Water Uses:_____
    - Water Demand per Type per Year (acre feet/year):_____
16. Total Water Demand Estimate at Full Build Out (acre feet/year):_____
17. Sources of Information Used for Demand Estimates:_____

General Groundwater Resource Information (30 TAC, §230.7).

18. Identify and describe, using Texas Water Development Board names, the aquifer(s) which underlies the proposed subdivision:_____

Note: Users may refer to Aquifers of Texas *(Texas Water Development Board Report 345, 1995) to obtain general information pertaining to the state's aquifers. This reference is available via the Internet (www.twdb.state.tx.us).*

Obtaining Site-Specific Groundwater Data (30 TAC, §230.8).

19. Have all known existing, abandoned, and inoperative wells within the proposed subdivision been located, identified, and shown on the plat as required under §230.8(b)? Yes No
20. Were the geologic and groundwater resource factors identified under §230.7(b) considered in planning and designing the aquifer test required under §230.8(c)? Yes No
21. Have test and observation wells been located, drilled, logged, completed, developed, and shown on the plat as required by §230.8(c)(1 though 4)? Yes No
22. Have all reasonable precautions been taken to ensure that contaminants do not reach the subsurface environment and that undesirable groundwater has been confined to the zone(s) of origin (§230.8(c)(5))? Yes No
23. Has an aquifer test been conducted which meets the requirements of §§230.8(c)(1 and 6)? Yes No
24. Were existing wells or previous aquifer test data used? Yes No
25. If yes, did they meet the requirements of §230.8(c)(7)? Yes No
26. Were additional observation wells or aquifer testing utilized? Yes No

Note: If expansion of an existing public water supply system or a new public water supply system is the anticipated method of water distribution for the proposed subdivision, site-specific groundwater data shall be developed under the requirements of 30 TAC, Chapter 290, Subchapter D (related to Rules and Regulations for Public Water Systems) and the applicable information and correspondence developed in meeting those requirements shall be attached to this form pursuant to §230.8(a).

Determination of Groundwater Quality (30 TAC, §230.9).

27. Have water quality samples been collected as required by §230.9? Yes No
28. Has a water quality analysis been performed which meets the requirements of §230.9? Yes No

Determination of Groundwater Availability (30 TAC, §230.10).

29. Have the aquifer parameters required by §230.10(c) been determined? Yes No

30. If so, provide the aquifer parameters as determined.

Rate of yield and drawdown:_____

Specific capacity:_____

Efficiency of the pumped well:_____

Transmissivity:_____

Coefficient of storage:_____

Hydraulic conductivity:_____

Were any recharge or barrier boundaries detected? Yes No

If yes, please describe:_____

_____

Thickness of aquifer(s):_____

31. Have time-drawdown determinations been calculated as required under §230.10(d)(1) Yes No

32. Have distance-drawdown determinations been calculated as required under §230.10(d)(2)? Yes No

33. Have well interference determinations been made as required under §230.10(d)(3)? Yes No NA

34. Has the anticipated method of water delivery, the annual groundwater demand estimates at full build out, and geologic and groundwater information been taken into account in making these determinations? Yes No

35. Has the water quality analysis required under §230.9 been compared to primary and secondary public drinking water standards as required under §230.10(e)? Yes No

Does the concentration of any analyzed constituent exceed the standards? Yes No

If yes, please list the constituent(s) and concentration measure(s) which exceed standards:_____

_____

Groundwater Availability and Usability Statements (30 TAC, §230.11(a)and (b)).

36. Drawdown of the aquifer at the pumped well(s) is estimated to be _____ feet over a 10-year period and _____ feet over a 30-year period.

37. Drawdown of the aquifer at the property boundary is estimated to be _____ feet over a 10-year period and _____ feet over a 30-year period.

38. The distance from the pumped well(s) to the outer edges of the cone(s)-of-depression is estimated to be _____ feet over a 10-year period and _____ feet over a 30-year period.

39. The recommended minimum spacing limit between wells is _____ feet with a recommended well yield of _____ gallons per minute per well.

40. Available groundwater is / is not (circle one) of sufficient quality to meet the intended use of the platted subdivision.

41. The groundwater availability determination does not consider the following conditions (identify any assumptions or uncertainties that are inherent in the groundwater availability determination):_____

_____

_____

_____

Certification of Groundwater Availability (30 TAC, §230.11(c)). Must be signed by a Texas Licensed Professional Engineer.

42. I, _____, Texas Licensed Professional Engineer, certificate number _____, based on best professional judgement, current groundwater conditions, and the information developed and presented in this form, certify that adequate groundwater is available from the underlying aquifer(s) to supply the anticipated use of the proposed subdivision.

Date:_____ (affix seal)

Revisions to
Comal County Subdivision Rules and Regulations

Approved by Order of the Comal County Commissioners Court on December 21, 2000.
This Order takes effect January 1, 2001.

1. Section A, Regulations, Subsection IV. PLATS, Subsection A. Preliminary Plats, Paragraph 6,

Revise item "x" to read as follows:

A person seeking approval of a plat which creates one or more lots or is seeking approval of a revision plat that results in an increase in the total amount of lots shall:

i) if no Public Water System is proposed or exists; and the proposed lots will be served by individual groundwater wells and not utilizing groundwater regulated by the Edwards Aquifer Authority,

Submit a Certification of Groundwater Availability For Platting Form pursuant to Title 30 Texas Administrative Code, Chapters 230, Sections 230.2 through and including 230.11, with the following additional requirements;

All supporting information, data, and calculations necessary to meet the requirements of Sections 230.2 through and including 230.11 shall be attached to the Certification of Groundwater Availability For Platting Form.

§230.3 (c), Form Required, the first sentence is revised as follows;

This chapter and the following form shall be used and completed if the county requires plat applicants to certify that adequate groundwater is available to provide water to the land to be subdivided.

Submit documentation from a Hydrogeologist indicating his/her concurrence with the findings presented within the above Certification of Groundwater Availability For Platting Form.

ii) if no Public Water System is proposed or exists; and the proposed lots will be served by individual groundwater wells utilizing groundwater regulated by the Edwards Aquifer Authority,

Provide an analysis prepared by a registered engineer determining the projected water use of the final expected number of residences, businesses, or other dwellings in the platted area.

Submit documentation from the Edwards Aquifer Authority indicating a permit allocation of groundwater rights to the proposed platted area in an amount adequate to meet the water needs as identified in the above engineering analysis. The permit allocation cannot involve leased water rights.

iii) if the proposed lots are to be served by a new Public Water System utilizing groundwater wells and not using groundwater regulated by the Edwards Aquifer Authority,

Submit a Certification of Groundwater Availability For Platting Form pursuant to Title 30 Texas Administrative Code, Chapters 230, Sections 230.2 through and including 230.11, with the following additional requirements;

All supporting information, data, and calculations necessary to meet the requirements of Sections 230.2 through and including 230.11 shall be attached to the Certification of Groundwater Availability For Platting Form.

§230.3 (c), Form Required, the first sentence is revised as follows;

This chapter and the following form shall be used and completed if the county requires plat applicants to certify that adequate groundwater is available to provide water to the land to be subdivided.

Submit documentation from a Hydrogeologist indicating his/her concurrence with the findings presented within the above Certification of Groundwater Availability For Platting Form.

Submit a copy of the final approval letter and all supporting documentation from the executive director of the Texas Natural Resource Conservation Commission (TNRCC), pursuant to TNRCC Rule 30 TAC Chapter 290.41(c)(3)(A), for each new well and provide a copy of the TNRCC approval letter and supporting documentation for the engineering plans and specifications for the Water Production and Water Distribution Facilities.

Provide a surety, in a form acceptable to the County, in an amount determined by the County Engineer, to ensure the proper completion of any and all Water Distribution Facilities such as water mains, valves, and other necessary water distribution appurtenances.

iv) if the proposed lots are to be served by a new Public Water System utilizing groundwater wells using groundwater regulated by the Edwards Aquifer Authority,

Provide an analysis prepared by a registered engineer determining the projected water use of the final expected number of residences, businesses, or other dwellings in the platted area.

Submit documentation from the Edwards Aquifer Authority indicating a permit allocation of groundwater rights to the proposed platted area in an amount adequate to meet the water needs as identified in the above engineering analysis. The permit allocation cannot involve leased water rights.

Submit a copy of the final approval letter and all supporting documentation from the executive director of the Texas Natural Resource Conservation Commission (TNRCC), pursuant to TNRCC Rule 30 TAC Chapter 290.41(c)(3)(A), for each new well and provide a copy of the TNRCC approval letter and supporting documentation for the engineering plans and specifications for the Water Production and Water Distribution Facilities.

Provide a surety, in a form acceptable to the County, in an amount determined by the County Engineer, to ensure the proper completion of any and all Water Distribution Facilities such as water mains, valves, and other necessary water distribution appurtenances.

v) if the proposed lots are to be served by a new Public Water System utilizing surface water,

Provide a copy of the TNRCC approval letter and supporting documentation for the engineering plans and specifications for any required Water Production and Water Distribution Facilities, pursuant to TNRCC Rule 30 TAC Chapter 290.

Provide an analysis prepared by a registered engineer determining the projected water use of the final expected number of residences, businesses, or other dwellings in the platted area.

Submit a copy of an executed contract, agreement, or commitment letter from the TNRCC or the Guadalupe Blanco River Authority stating surface water, in an amount adequate to meet the water needs as identified in the above engineering analysis, has been committed to the platted area for a period of 20 years or greater. Said document shall identify the amount of surface water committed, the point of diversion, and the term of the commitment.

Provide a surety, in a form acceptable to the County, in an amount determined by the County Engineer, to ensure the proper completion of any and all Water Distribution Facilities such as water mains, valves, and other necessary water distribution appurtenances.

vi) if the proposed lots are to be served by an existing public water system utilizing groundwater and currently providing service to less than 1000 connections,

Provide documentation from the existing Public Water System indicating that the existing system has agreed to provide water service to the platted area.

Provide a copy of the latest TNRCC Public Water Sanitary Survey of the existing Public Water System indicating no alleged violations pertaining to water quality or water production capability.

Provide an engineering analysis of the existing Public Water System showing that the existing system has an adequate Water Supply and adequate Water Production Facilities to serve the final expected number of residences, businesses, or other dwellings in the existing service area in addition to the needs of the final expected number of residences, businesses, or other dwellings in the proposed platted area.

If the existing public water system uses groundwater regulated by the Edwards Aquifer Authority, submit documentation from the Edwards Aquifer Authority indicating the permit allocation of groundwater rights necessary to meet the needs identified to the preceding paragraph. The permit allocation cannot involve leased water rights.

If an expansion to an existing Public Water System is necessary due to the addition of the platted area or due to existing deficiencies in the system, as identified above, submit a copy of the final approval letter and all supporting documentation from the executive director of the Texas Natural Resource Conservation Commission (TNRCC), pursuant to TNRCC rule 30 TAC Chapter 290.41 (c)(3)(A), for any new well, and provide a copy of the TNRCC approval letter and supporting documentation for the engineering plans and specifications for the required Water Production and Water Distribution Facilities.

Provide a surety, in a form acceptable to the County, in an amount determined by the County Engineer, to ensure the proper completion of any and all Water Distribution Facilities such as water mains, valves, and other necessary water distribution appurtenances.

vii) if the proposed lots are to be served by an existing Public Water System utilizing surface water or an existing Public Water System currently providing interconnected water service to 1000 connections or more,

Provide documentation from the existing Public Water System (Utility) indicating that the Utility has agreed to provide water service to the platted area.

Provide documentation from the Utility indicating that the Utility has had a Water Availability Report approved by the Comal County Commissioners Court within the last 36 months.

A Water Availability Report is defined as a document prepared by the Utility to reveal their ability to meet the needs of their existing users and show their preparedness to meet the needs of future water users as their system expands. The report shall include, but is not necessarily limited to, the following:

1. Copy of the latest TNRCC Public Water Sanitary Survey of the Utility's existing water system indicating no alleged violations pertaining to water quality or water production capability.
2. A map or maps of the Utility's service area showing:
    a) the Utility's current service area as define by their existing Certificate of Convenience and Necessity and the projected service area in 20 years.
    b) a schematic of the Utility's existing distribution system with line sizes identified.
    c) locations of water wells and/or surface water plants with capacities.
    d) locations of pump stations and elevated storage tanks with capacities.

3. An analysis of the population and land use development projections for the Utility's estimated service area in 20 years.
4. Copies of documents and/or an engineering analysis showing that the Utility has adequate groundwater rights, surface water rights, existing groundwater production capability, or other proofs of water rights or reservations in an amount sufficient to supply the anticipated water use of the expected population and land use within the projected service area in 20 years.
5. In areas where groundwater withdrawal is not regulated by the Edwards Aquifer Authority, if applicable, provide a report prepared by a registered engineer certifying that adequate groundwater is available from the source aquifer(s) to supply the Utility's anticipated groundwater needs for 20 years.

2. Section A, Regulations, Subsection 1, Authority and Purpose;

Add the following:

5. Plat Requirement

a) The owner of a tract of land located outside the limits of a municipality must have a plat of the subdivision prepared if the owner divides the tract into two or more parts to lay out:
   (1) a subdivision of the tract, including an addition;
   (2) lots; or
   (3) streets, alleys, squares, parks or other parts of the tract intended to be dedicated to public use or for the use of purchasers or owners of lots fronting on or adjacent to the streets, alleys, squares, parks, or other parts.

b) A division of a tract under Subsection (a) includes a division regardless of whether it is made by using a metes and bounds description in a deed of conveyance or in a contract for a deed, by using a contract of sale or other executory contract to convey, or by using any other method.

6. Exemptions to the Plat Requirement

The following exemptions may allow a division of property without the preparation of a subdivision plat. Under these exemptions, a property owner may not be required to prepare a subdivision plat for their division of their property, but the division of property must still meet the minimum lot size requirements set forth in the Comal County On-Site Sewage Facility Order.

a) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into two or more parts to have a plat of the subdivision prepared if

   (1) the land is to used primarily for agricultural use, as defined by Section 1-d, Article VIII, Texas Constitution, or for farm, ranch, wildlife management, or timber production use within the meaning of section 1-d-1, Article VIII, Texas Constitution; and

   (2) the owner does not lay out a part of the tract described by above in 5. a(3); and

   (3) if the tract described ceases to be used primarily for agricultural use or for farm, ranch, wildlife management, or timber production use, the platting requirements apply.

b) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into four or fewer parts to have a plat of the subdivision prepared if:

   (1) each of the lots is sold, given, or otherwise transferred to an individual who is related to the owner within the third degree of consanguinity of affinity, as determined by Chapter 573, Government Code;

   (2) the owner does not lay out a part of the tract described by 5. a(3); and

(3) if any lot is sold, given, or otherwise transferred to an individual who is not related to the owner within the third degree consanguinity or affinity, the platting requirements apply.

c) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into two or more parts to have a plat of the subdivision prepared if:

(1) all of the lots in the subdivision are more than 10 acres in area; and

(2) the owner does not lay out a part of the tract described in 5. a(3).

d) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into two or more parts and does not lay out a part of the tract described in 5. a(3) to have a plat of the subdivision prepared if all of the lots are sold to veterans through the Veteran's Land Board Program.

e) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into two or more parts to have a plat of the subdivision prepared if:

(1) the owner does not lay out a part of the tract described in 5. a(3); and

(2) one new part is to be retained by the owner, and the other new part is to be transferred to another person who will further subdivide the tract subject to the plat approval requirements of these regulations.

f) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into two parts to have a plat of the subdivision prepared if:

(1) the owner does not lay out any part of the tract described in 5. a(3); and

(2) all parts are transferred to persons who owned undivided interest in the original tract and a plat is filed before any further development of any part of the tract.

g) The County shall not require the owner of an unplatted or platted tract of land located outside the limits of a municipality who divides the tract into two parts to have a plat of the subdivision prepared if:

(1) the owner does not lay out any part of the tract described in 5. a(3); and

(2) the subdivision is the result of the owner dividing a tract by granting a security interest in property to secure an indebtedness.

h) The County shall not require the owner of an unplatted tract of land located outside the limits of a municipality who divides the tract into two parts to have a plat of the subdivision prepared if:

(1) the owner does not lay out any part of the tract described in 5. a(3); and

(2) the subdivision is the result of the owner dividing a tract to convey property to an adjacent property owner.

i) The County shall not require the owner of a tract of land located outside the limits of a municipality to have a plat or revision plat of the subdivision prepared if:

(1) said tract was created prior to January 1, 2001, as evidenced by a document recorded in the Comal County Clerk's records before January 1, 2001; or

(2) said tract was the result of a division of land that resulted from the acquisition of public right-of-way by Comal County or the State of Texas.

3. **Section A, Regulations, Subsection II, Definition of Terms**

Delete definition for "Subdivision"

Add the following definitions:

Public Water System - A system, approved by the Texas Natural Resource Conservation Commission, for the provision to the public of water for human consumption through pipes or other constructed conveyances.

Water Production Facility – A collection of pumps, treatment equipment, tanks and other devices designed to extract water from a source, provide necessary treatment to purify and disinfect, pressurize, pump, and store potable water.

Water Distribution Facility – a system or network of pipes and valves designed to deliver potable water to users.

Water Supply – a source of water

Hydrogeologist – An individual with at least 5 years of progressively more responsible professional experience, following receipt of a baccalaureate degree, during which full competence has been demonstrated in the application of scientific or engineering principles and methods to the execution of work involving:
(1) the understanding of the occurrence, movement, and composition of ground water in relation to the geologic environment,
(2) the development, management, or regulation of ground water, or
(3) the teaching and research of ground water subjects at the university level.

HAYS COUNTY

SUBDIVISION AND DEVELOPMENT REGULATIONS

EFFECTIVE DATE: JUNE 3, 1997. AMENDED JUNE3, 2003

HAYS COUNTY SUBDIVISION AND DEVELOPMENT REGULATIONS

ARTICLE I

1. Preamble and Purpose

1.1 These Subdivision and Development Regulations have been adopted by Order of the Hays County Commissioners Court to provide a framework for the orderly and efficient development of rural and suburban Hays County.

1.2 These Subdivision Regulations have been adopted based on the following findings:

(a) The Commissioners Court of Hays County has the authority to regulate the subdivision process pursuant to Local Government Code, §232.001 et seq.;

(b) The Commissioners Court of Hays County has been designated by the Texas Commission on Environmental Quality as the authorized agent for the licensing and regulation of on-site sewerage facilities within Hays County and these Regulations are a necessary component of such regulation;

(c) The Commissioners Court of Hays County has the authority and obligation to exercise general control over the roads, highways, bridges and related drainage structures and development within Hays County;

(d) The Commissioners Court of Hays County has been granted the authority and responsibility under the Federal Emergency Management Act to administer floodplain development regulations within the County and to regulate associated development;

(e) The Commissioners Court of Hays County has considered the potential pollution, nuisances and injury to public health that could be caused by the use of private sewerage facilities within the County and has adopted these Regulations to abate or prevent the potential pollution, nuisances or injury to public health;

(f) The Commissioners Court of Hays County has the authority and obligation to protect the public health, safety, morals, or general welfare of the citizens of Hays County as provided in Chapter 232.100 Texas LGC;

(g) These Regulations are enacted to implement the powers conveyed to counties under the laws of the State of Texas, including but not limited to Tex. Rev. Stat. Ann. Art. 2352 (general control over all roads, highways and bridges), Tex. Rev. Stat. Ann. Art. 6702-1 (authority to adopt and implement a system for the laying out, opening, altering and discontinuing of roads), Tex. Rev. Stat. Ann. Art 6626a (regulations of roads and streets and other facilities to control drainage

and storm water runoff within real estate subdivision developments), Tex. Rev. Stat. Ann. Art. 4477-8 (county solid waste disposal systems), Tex. Rev. Stat. Ann. Art. 1443, 1443a and 1436b (regulation of water and gas utility lines within county right-of-way), Tex. Rev. Stat. Ann. Art. 4477-7e (authority to adopt standards for on-site sewerage facilities), Tex. Rev. Stat. Ann. Art. 4477-9a (regulation of public highways for litter control), Tex. Local Gov't Code Ann. Section 232.001, et seq. (authority to adopt and enforce subdivision regulations and require plat approval), Tex. Local Gov't Code Ann. Section 242.001 (authority to regulate subdivisions pursuant to all statutes applicable to counties within the extraterritorial jurisdiction of municipalities), Tex. Health and Safety Code Ann. Sections 366.032 and 368.011 (authority to adopt rules relating to on-site sewerage facilities), Tex. Health and Safety Code Sections 121.003 and 122.001 (authority to enforce laws and appropriate funds necessary to protect public health), Tex. Water Code Ann. Section 16.311, et seq. (authority to set standards for construction within floodplain and to guide development of future development to minimize damage caused by floods), Tex. Water Code Ann. Section 54.2271 (regulation of municipal utility districts), Tex. Water Code 26.032 (authority to adopt rules to prevent pollution or injury to public health arising from use of on-site sewerage facilities), and Tex. Water Code Sections 26.171 and 26.175 (regulation of water quality by counties);

(h) The Commissioners Court has considered the potential burden on landowners and taxpayers of substandard development or poor quality road construction;

(i) Significant portions of Hays County are subject to the Edwards Aquifer Rules of the Texas Commission on Environmental Quality and, where feasible, reference is made to these Rules in these Regulations in order to provide property owners with a consistent framework for development throughout Hays County, but with a recognition that the Texas Commission on Environmental Quality retains the exclusive jurisdiction to enforce and administer the Edwards Aquifer Rules;

(j) These Regulations are enacted to preserve and protect the resources, public health and private property interests of Hays County.

(k) Water Availability requirements are authorized through the Texas Water Code Chapter 35 Sec. 35.019 and based on a finding by the Texas Water Development Board that since 1990 water usage within this priority groundwater management area has exceeded supply.

1.3 The Commissioners Court of Hays County, following public notice, investigation and hearing, has declared and hereby declares these Regulations to be necessary and appropriate to accomplish the purposes and goals enumerated above.

3.11 Wastewater and Development Permits. The Department shall issue no On-Site Sewage Facility or development permit on any parcel of land unless that property is in compliance with all the requirements of these Regulations and the Hays County Rules for On-Site Sewerage, except that:

(a) A division of land occurring before June 1, 1984 shall be considered grandfathered;

(b) A complete application for subdivision approval received by the Department prior to the effective date of these Regulations shall be considered solely on the basis of the Regulations in effect at the time the complete application was received by the Department.

3.12 Water Availability Requirements. While these rules are intended to preserve and protect the water resources of Hays County, the Commissioners Court of Hays County does not make any warranty - express, implied or otherwise - that subdivisions that comply with these rules will be able to meet the water needs of those purchasing lots within the subdivision.

Applicability: This section shall apply to all individuals seeking plat approval from the Hays County Commissioners Court.

Exemptions:

(a) All subdivisions of five lots or less in which all lots average at least 2 acres each.
(b) All subdivisions of ten lots or less in which all lots are larger than ten acres.
(c) All subdivisions in which all lots are restricted by plat note to be served only by rainwater collection or surface water sources.
(d) All subdivisions of property for the purpose of conveyance to family members up to the second order of sanguinity in which all lots average at least 2 acres, and in which each lot is to be used only for their personal single family residence

Requirements:

1. Subdivisions to be served by individual private water wells:

- Applicants requesting plat approval shall construct at least two wells (one test well and one monitor well). Use of existing wells will be permitted if the wells fully meet these regulations. Well analyses shall be performed by a State of Texas Registered Professional Engineer or Hydrogeologist, qualified to perform the hydrogeological testing, geophysical well logging and aquifer pump testing. The following information shall be provided to Commissioners Court for each well tested.

(a) Identify the hydrogeologic formation by well driller's log and approved geophysical logging methods. Provide a map and list of all known wells within 1,000 feet of the proposed subdivision boundaries (or a distance where measurable drawdown effects from the proposed subdivision well are

expected). Each well is to be located by latitude and longitude.

(b) Obtain the static water level to the nearest one tenth foot and equate to the mean sea level elevation. Hays County reserves the right to maintain selected monitor well sites for long-term data acquisition of static water levels in order to track regional water level trends. The test and monitor wells shall contain a one inch plug to facilitate possible future water level monitoring.

(c) Perform an aquifer pump test using approved methods of the karst aquifer systems of the Texas Hill Country. The pump test shall be performed prior to any acidization or other flow capacity treatment. The duration of the pump test shall be 24 hours or until the water level has stabilized (less than one tenth foot fluctuations) in the test well for a period exceeding two hours. The constant pumping rate used in the pumping test shall be at least the average rate of pumping for water supply use. Following pumping, water level measurements will be continued in the test and monitor wells until levels recover to their original static levels.

(d) Using information from the aquifer pump test, calculate aquifer properties including transmissivity, hydraulic conductivity, and storage coefficient of the test and monitor wells.

(e) Using aquifer properties and proposed pumping rates for the full subdivision build-out, provide cumulative drawn-down calculations for selected radial distances up to 1,000 feet of the proposed subdivision boundaries, or a distance where measurable draw-down effects at known wells identified in (a) are expected.

(f) The bacterial and chemical analysis of the test well as provided in 30 TAC 230.9.

- Individuals marketing these subdivision lots shall provide each purchaser with a summary of all the above referenced data.

2. Subdivisions to be served by TCEQ permitted public water supplies:

- Individuals proposing to serve a new subdivision by a public water supply system established to serve the new subdivision shall provide to commissioners court the following information:

(a) Certification that the public water supply system has sufficient capacity and acceptable water quality to serve all the proposed development for the subdivision.

(b) A map identifying the service boundaries of the public water supply as authorized in their Certificate of Convenience and Necessity.

(c) A projection of the annual water usage generated by the new subdivision at build-out.

(d) When new wells are being constructed to serve a TCEQ permitted water supply, provide a map and list of all known wells within 1,000 feet of the proposed subdivision boundaries (or a distance where measurable draw-down effects from the proposed subdivision wells are expected).

(e) This subparagraph does not include previously approved public water supplies by TCEQ or expanded CCN's.

3. Subdivisions to be served by an existing public water supply as permitted by TCEQ shall provide:

(a) A letter from the public water supply company certifying that the public water supply has sufficient capacity to serve all the proposed development for the subdivision.
(b) A projection of the annual water usage generated by the new subdivision at full build-out.

ARTICLE IV

4. Exemptions

4.1 Exempted Subdivisions.

a) Exemptions are allowed as defined by Local Government Code 232.0015.
b) Exemptions must have direct access (fee simple) to a permitted road.

4.2 Registration. An Owner whose subdivision is exempt from the platting requirements of these Regulations shall register the division with the County Clerk and submit the following to the County Clerk:

(a) A duplicate copy of the recorded conveyance instrument, with legible metes and bounds description attached thereto;

(b) A survey or sketch (which may be on tax parcel maps or other form approved by the Department) showing the boundaries of the Lots, adjacent roads and adjacent property owners;

(c) An executed registration form in the form promulgated by the Department which shall require the Owner to acknowledge that all Lots remain subject to the on-site wastewater rules and development permit requirements of the County.

(d) An affidavit stating that the owner/subdivider of the land acknowledges that any change to the exemption will require the platting of the property through the Hays County Commissioners Court.

ARTICLE V

5. Preliminary Plan.

5.1 Information. A proposed Preliminary Plan shall include the following:

(a) General Information.

(1) Name of the proposed Subdivision, which shall not be the same or deceptively similar to any other subdivision within the County unless the subdivision is an extension of a pre-existing, contiguous subdivision.

(2) The boundary lines and total acreage of the Original Tract and the Subdivision.

(3) A note stating the total number of Lots within the proposed subdivision and the average size of Lots, and the total number of Lots within the following size categories: 10 acres or larger, larger than 5.0 acres and smaller than 10 acres, 2.00 acres or larger up to 5.00 acres, larger than 1.00 acre and smaller than 2.0 acres and smaller than 1.00 acre.

(4) Approximate acreage and dimensions of each Lot.

(5) The location of any proposed parks, squares, greenbelts, schools or other public use facilities.

(6) Names of adjoining subdivisions or owners of property contiguous to the proposed Subdivision.

(7) Name and address of the surveyor and/or engineer.

(8) Name and address of the Owner, and developer or applicant if not the Owner.

(9) Area map showing general location of Subdivision in relation to major roads, towns, cities or topographic features.

(10) North arrow, scale and date. The scale shall not exceed 1" = 200'.

(11) Boundary lines of any incorporated city and the limit of the extraterritorial jurisdiction of any city.

(12) The location of school district boundaries and a statement clearly indicating in which school district(s) the Subdivision is located. In the event any Lot lies

within more than one school district then the plat shall clearly state the number of acres within the Lot that lies within each school district.

(b) Flood Plain and Drainage Information.

(1) Elevation contours at no greater than ten-foot (10') intervals, based on NGVD '29 datum.

(2) All Special Flood Hazard Areas identified by the most current flood Insurance Rate Maps published by the Federal Emergency Management Agency.

(3) For each Lot containing 100-year floodplain, sufficient additional contours to identify and delineate the 100-year floodplain and regulatory floodway, if any. If base flood elevations have not already been established, they shall be established by a method satisfactory to the Director.

(4) For each subdivision containing 100-year floodplain, at least one benchmark showing NGVD '29 elevation, as well as latitude and longitude.

(5) A drainage plan depicting the anticipated flow of all drainage onto and from the subdivision and showing all major topographic features on or adjacent to the property including all water courses, 100 year floodplain boundaries, ravines, bridges and culverts.

(6) The location and size of all proposed drainage structures, including on-site retention or detention ponds and easements and the impact of lot and street layouts on drainage.

(7) General depiction of the boundary lines of the Edwards Aquifer Recharge Zone, or the Contributing Zone of the Barton Springs Segment of the Edwards Aquifer (as defined in the Rules of Hays County for On-Site Sewage Facilities), if affecting the property, and a statement certified by the surveyor or engineer under his or her professional seal that, to the best of his or her knowledge, the plat accurately reflects the general location (or absence) of the Edwards Aquifer Recharge Zone or the Contributing Zone of the Barton Springs Segment of the Edwards Aquifer.

(8) Depiction of all streams, rivers, ponds, lakes, other surface water features or any Sensitive Features (as defined by the *Texas Commission on Environmental Quality* in 30 Texas Administrative Code §213.3) and a statement certified by the surveyor or engineer under his or her professional seal that, to the best of his or her knowledge, the plat accurately reflects the general location (or absence) of all such features in accordance with the terms of these Regulations.

Travis County

Exhibit 82.201(c)

TNR's Non-Legislative Version 7/26/05

Travis County TNR Planning and Engineering Services Division
411 West 13th Street, Executive Office Building, 8th Floor, P.O. Box 1748, Austin, TX 78767
phone (512) 854-9383 fax (512) 854-4649

FINAL PLAT APPLICATION COMPLETENESS REVIEW FORM

This form represents the standard requirements for a completeness review all final plat applications. Failure to provide all of the information requested may result in the determination that the final plat application is incomplete. The application will be reviewed for completeness, not correctness. The correctness review will be based on the requirements of Chapter 82 of Travis County's Standards for Construction of Streets and Drainage in Subdivisions.

Project Name on Plan: _____ Date: _____

Application Type: [ ] Short Form Plat (no proposed streets) [ ] Long Form Plat (proposed streets)

[ ] Resubdivision/Amended (Plat Name) _____

Street Location: _____ Property Acreage: _____

Precinct: _____ Other Jurisdiction (City ETJ, etc.): _____

Approved Preliminary Plan Name: _____

Tax Map Parcel ID: _____ Watershed: _____

FEMA Floodplain Panel Number(s): _____

Signature of Property Owner or Agent*: _____ Email: _____

Printed Name: _____ Phone: _____ Fax: _____

** Attach written authorization signed by the Owner of Record designating him/her as agent for this project.*

DEPARTMENTAL USE ONLY

Date Filed: _____ Staff Name: _____

Final Plat Application Checklist Items marked with a "check" are complete, complete all circled items. "NA" means not applicable.

[ ] 1. One (1) copy of Final Plat (drawn at 1"=100'). Also, for all commercial subdivisions and for any single-family residential subdivision over 20 acres, digital drawing file of subdivision.

[ ] 2. All subdivision plat sheets shall be 18" x 24".

[ ] 3. Plat original must be drawn in black ink on mylar or vellum material.

[ ] 4. The subdivision name must be prominently displayed on each sheet of the plat.

[ ] 5. Each sheet of the plat must be sequentially numbered (example "Sheet 2 of 4").

[ ] 6. Location map, legend and north arrow comply with Preliminary Plan standards.

[ ] 7. Lot and block numbers must be systematically and sequentially arranged.

[ ] 8. Adjacent property must be referenced by book and page of Travis County Plat Records with lot and block numbers. Unplatted adjacent land must be referenced by property owner, acreage and volume and page Travis County Real Property Records.

[ ] 9. All existing and proposed easements must be shown and labeled. Existing easements must reference the holder of easement and recording information. Provide one (1) copy of all existing separate instrument easement documents.

[ ] 10. A letter, statement, or other instrument from holder of privately held easement or fee strip stating their approval of crossing or modification of the easement.

[ ] 11. Reference any covenants or restrictions imposed on the land by volume and page of Travis County Real Property Records. Provide one (1) copy of covenants/restrictions.

[ ] 12. The names and right-of-way widths of all adjacent streets must be shown.

[ ] 13. The name, linear footage and width of each street being platted must be listed.

[ ] 14. Bearings and distance for every street, lot line and easement whether curved or tangent. The radius, central angle, arc, chord, chord bearing, and tangent distance for all curves. Dimensions shown in feet and hundredths of a foot and angles must be shown in degrees, minutes, and seconds.

[ ] 15. Location of all permanent monuments and control points, including County line monumentation, if applicable, set as described in Section 82.204(c)(12) and shown on plat as per Section 82.204(c)(12) of Travis County's Standards.

[ ] 16. All drainage easements must be shown in accordance with the Preliminary Plan.

[ ] 17. Dedication of 100 year flood plain in drainage easements clearly delineated using bearings and distances.

[ ] 18. Contain all natural drainageways in drainage easements when drainage leaves or crosses existing or proposed right-of-way or when natural drainageways cross multiple lots or as determined by Travis County TNR. Clearly delineated using bearings and distances. Or provide a grading plan and the following plat note: Construction on Lot(s) ____, will not cause ponding, erosion or increased flow on adjacent properties.

[ ] 19. If there is a drainage easement, add note: "No objects, including but not limited to buildings, fences, landscaping or other structures in drainage easements except as approved by Travis County and the City of _____."

[ ] 20. For any lot affected by the 100 year flood plain, a Minimum Finished Floor Elevation must be established for each affected lot in accordance with Travis County's Standards. If multiple base flood elevations are shown for a single lot, include the following plat note: Finished flood elevation on lot ___ shall be one (1) foot above the highest adjacent FEMA flood plain base flood elevations shown hereon.

[ ] 21. One or more benchmark monumented in subdivisions which contain or are bounded by flood plain or where new street are dedicated.

[ ] 22. The acreage of each Lot served by an onsite sewage system must be noted.

[ ] 23. Total acreage and number of lots listed on plat.

[ ] 24. The usage of each lot that is not single family residential must be noted on plat.

[ ] 25. Preamble describing exact legal description and referencing applicable statute.

[ ] 26. Surveyor certification is on the plat.

[ ] 27. County Clerk 's Affidavits on the plat.

[ ] 28. Commissioners' Court resolution.

[ ] 29. ETJ note (to be signed prior to final plat approval) by the Director of Planning for the City of Austin (or other city as applicable) when property is outside the ETJ.

[ ] 30. Appropriate notes and signature blocks for officials of other jurisdictions.

[ ] 31. Travis County Development Permit required prior to any site development.

[ ] 32. Travis County Flood plain note.

[ ] 33. Individual sewage disposal system notes and signature block.

[ ] 34. Plat note prohibiting occupancy of any lot until connection is made to an approved public sewer system or approved private individual sewage disposal system.

[ ] 35. Plat note prohibiting occupancy of any lot until water satisfactory for human consumption is available from a source in adequate and sufficient supply for the proposed development.

[ ] 36. Plat note designating proposed water and/or wastewater provider.

[ ] 37. If groundwater will be relied on to provide the water supply to the subdivision, the material required by 30 Texas Administrative Code Chapter 230.

Supplemental Submittal Information Required Before Final Plat Approval

[ ] 38. A letter from each utility company (electric power, telephone, gas, water and wastewater) serving the immediate area, indicating whether and when service will be available to all lots in the subdivision. For water and/or wastewater, the letter must be accompanied by a contract for service and construction of any new water/wastewater facilities.

[ ] 39. A tax certificate from the County Tax Assessor-Collector stating that all real property taxes are paid up to and including the preceding tax year.

[ ] 40. Copy of current Owner's Property Deed.

[ ] 41. Copy of Restrictive Covenants or Joint Use Driveway Agreement if joint use driveways are proposed.

[ ] 42. Copy of Restrictive Covenants/Home Owners Agreement. (existing or proposed if required for common areas).

[ ] 43. Copy of preliminary street and drainage plans and detailed construction estimate signed and sealed by the engineer. *The application may be rejected if insufficient information is provided. Fiscal posting may need to be increased if the complete construction warrant a higher fiscal posting amount.. Complete construction plans and fiscal for restoration and the construction of streets and drainage must be provided prior to issuance of development permit, unless alternate fiscal is approved by the Court. The owner must provide fiscal or an executed copy of Exhibit 82.401(D) plus restoration fiscal within 48 hours of notice that the plat is to be recommended to the Court for approval and recordation or the plat may be rejected. (See supplemental checklist for streets and drainage plans).*

[ ] 44. Topographic information, drainage area map, drainage plan, and drainage report. *(If different from Preliminary Plan submittal - see supplemental checklist for streets and drainage plans).*

[ ] 45. Electronic media submittal. *(optional)*

[ ] 46. Copy of Preliminary Plan for long form plat submittals. *A separate Preliminary Plan will not be required if the applicant is final platting the entire parent tract and provides the information required with preliminary plans. (See preliminary plan checklist)*

[ ] 47. Copy of Traffic Impact Analysis, if required as per 82.301(b).

[ ] 48. Copy of all variance requests with appropriate supporting documentation.

[ ] 49. For developments with sidewalks, approval letter from Department of Licensing and Regulation, or a letter from a Texas Registered Professional Engineer, an architect or other profession acceptable to the Texas Department of Licensing and Regulation, stating that the design of any public accommodations meets ADA requirements, or a waiver to the requirements has been granted by TDLR, per 82.301(c)(B).

[ ] 50. Copy of Travis County Construction Agreement.

[ ] 51. Letter of concurrence from emergency service provider.

[ ] 52. Written approval for all proposed street names from E-911 Addressing.

[ ] 53. Permits or approvals from federal, state, or regional entities with jurisdiction. If the limits of 100 year flood plain as per FEMA vary from the current FEMA panels, provide proof of application to FEMA for a Conditional Letter of Map Amendment (CLOMA) or Conditional Letter of Map Revision (CLOMR). A Conditional Letter of Map Amendment, or Revision, must be provided prior to final plat approval and the Letter of Map Amendment or Revision must be provided prior to issuance of development permits for lot improvements.

[ ] 54. Travis County Subdivision Fees Calculation Form and receipt of payment of all required fees.

[ ] 55. Water quality control maintenance plan under Section 82.209(h), if applicable.

Private Street Subdivision

[ ] 56. Preamble contains private street language.

[ ] 57. Private streets are shown on plat as "Private Street, Drainage Easement and PUE".

[ ] 58. One (1) copy of Home Owners Agreement.

[ ] 59. If gates are proposed, provide an entry detail showing location of gates, key pads, etc.

On this date, all items necessary for a technical review of the proposed Final Plat have been submitted and constitute a COMPLETE APPLICATION. More information about the items required herein can be obtained from Travis County, Standards for Construction of Streets and Drainage in Subdivision (Chapter 82). A copy of these standards can be obtained from TNR at 411 West 13th Street, 8th floor, (512) 854-9383 or on the Travis County web page: http://www.co.travis.tx.us/tnr/subdivision.

Application Completed: Staff Name:

Report #	County	Pump Well ID	Consultant(s)	Certified By	Developer	Pump Test Date	Alternate Location	Lat	Long	Aquifer	Aquifer Type	Pump Well depth	Screen Diam. ft.	Open Interval ft.	Pump Rate gpm	Pump Period hrs	Max-Drawdown ft.	Mon. Well	Dist from pump well ft.	Init. WL ft bgs	Final WL ft bgs	Aquif Thick ft.	Fully Penetrated	T gpd/ft	S	K gpd/ft^2	Spec Cap gpm/ft	Well Effic. (%)	Est. drawdown ft. bgs	Rec. Well Spac.	Chemical Analyses	Comments
1	Gillispie	PW-3	Pape-Dawson Engineers	Philip Pearce, PG 691	River Run R. V. Park	7/20/2004	N.A.	30.2308	-99.1833	Middle Trinity	Confined	900	0.53	170	265	24	129.4	Y	530	-210.96	-344.99	270	Assumed	3,135	0.000155	11.6	2	94	24 feet after 30 years at property boundary		Yes, no analysis included	
2	Gillispie	Lot 12	Marshall E. Jennings	Marshall E. Jennings, P. E. 26130	High River Ranch Subdivision	1/21/2005	N.A.	30.2025	-98.9597	Hensell Member, Middle Trinity	Semiconfined	193	0.53	150 - 190	17.6	24	11.4	Y	311	-127.71	-140.55	200	Assumed	6,140	0.000018	30.6	1.54	85	1.1 feet after 30 years at property boundary	300 feet at 0.2 gpm	Yes, T. Hard 394, Ca 49, Mg 66, Na 42, SO4 59, Cl 69, F 0.6, TDS 480	Possible local recharge boundary
3	Blanco	PW-1	Hill Country Engineering and Bond Geological Services	Michael Lucci, P.E. 82822 and Steve Bond PG 518	Rockin J Ranch Subdivision Units, 1 & 2	4/14/2004	N.A.	30.0467	-98.4017	Middle Trinity	Unconfined	340	0.53	240 - 340	155	36	1.87	Y	200	-173.79	-175.66	90	Assumed	345,000	0.001	3837	82.9		N. A.		SO4 161, TDS 580	Located in fault block, high perm. and porosity. Tests were conducted during high rainfall event
3.1	Blanco	PW-2	Hill Country Engineering and Bond Geological Services	Michael Lucci, P.E. 82822 and Steve Bond PG 518	Rockin J Ranch Subdivision, Units 1 & 2	4/17/2004	N.A.	30.0433	-98.3953	Middle Trinity	Unconfined				145	36	0.72	Y	200	-216.12	-216.84	90	Assumed	595,000	0.001	6620	201.4		N. A.			Located in fault block, high perm. and porosity. Tests were conducted during high rainfall event
4	Blanco	BT-3	Strata Geological Services Inc.	William Feathergail Wilson PG 21	Brushy Top Ranch Subdivision	9/11/2005	N.A.	30.1624	-98.3955	Lower Trinity, Hosston	Confined	580	0.38	460 - 520	13.6	2	91.98	N		-217		60	Assumed	108	3.88E-05	1.8	0.15		N. A.	10 acres	1,850 to 2,200 TDS	
4.1	Blanco	BT-1	Strata Geological Services Inc.	William Feathergail Wilson PG 21	Brushy Top Ranch Subdivision	9/11/2005	N.A.	30.1516	-98.4018	Lower Trinity, Hosston	Confined	670	0.38	560 - 620				N		-295									N. A.	10 acres		
5	Blanco	1A	Edwards Aquifer Research and Data Center	Marshall E. Jennings, P. E. 26130 and John Burch (evaluated by LBG-Guyton)	Crystal Mountain Development, Phases III and IV	8/16/2000	N.A.	30.455	-98.3561	Ellenburger-San Saba	Partially Confined	460	0.5	160 - 460	15	24	73.94	N	300	-167.46	-241.43	300	Assumed	183	0.00014		0.2		N. A.	500 feet	Yes, T. Hard 401, Ca 80, Mg 49, Na 16, SO4 32, Cl 10, F 0.5, TDS 409	Estimated aquifer thickness
5.1	Blanco	4A	Edwards Aquifer Research and Data Center	Marshall E. Jennings, P. E. 26130 and John Burch (evaluated by LBG-Guyton)	Crystal Mountain Development, Phases III and IV	8/20/2000	N.A.	30.4800	-98.3497	Ellenburger-San Saba	Partially Confined	385	0.5	180 - 385	17	24	7.33	Y	300	-141.74	-149.07	305	Assumed	7,970	0.0017		3.1		N. A.	500 feet		Estimated aquifer thickness
6	Blanco	Sect. 2	Winkley Engineering	Thomas Winkley and Thomas Partridge (evaluated by LBG-Guyton)	Cielo Springs Subdivision, Sections 2 and 3	01/21/2000	N.A.	30.0739	-98.4182	Middle Trinity, Lower Glen Rose	Partially Confined	500	0.5	280 - 355, 450 - 460, 475 - 500	19	24	41.05	Y	120	-172.5	-213.55	110	Assumed	319	0.00005	2.9	0.46		N. A.		No, T. Hard 240, Ca 544, Mg 304, Na 75, SO4 3,040, Cl 34, F 2.9, TDS 3,730, pH 8.0	
6.1	Blanco	Sect. 3	Winkley Engineering	Thomas Winkley and Thomas Partridge (evaluated by LBG-Guyton)	Cielo Springs Subdivision, Sections 2 and 3	01/21/2000	N.A.	30.0877	-98.4320	Middle Trinity, Lower Glen Rose	Partially Confined	560	0.5	367 - 371, 465 - 560	20	24	106.4	Y	120	-121.2	-227.6	99	Assumed	444	0.000099		0.18		N. A.		No, T. Hard 210, Ca 587, Mg 261, Na 94, SO4 2,910, Cl 41, F 3.3, TDS 3,570, pH 7.5	
7	Blanco	1(P)	Marshall E. Jennings	Marshall E. Jennings, P. E. 26130	The Lake on Flat Creek	2/27/2004	N.A.	30.2892	-98.4228	Ellenburger-San Saba	Confined	364	0.53	110 - 337	8.8	24	107.45	Y	181	-41.55	-149		Assumed	625	0.00027		0.07		pumping at 0.3 gpm/well, 1.6 feet drawdown 1,000 feet from property boundary after one year		Yes, T. Hard 362, Ca 69, Mg 46, Na 14, SO4 12, Cl 10, F 0.3, TDS 326	Unknown aquifer thickness used for analysis
7.1	Blanco	2(P)	Marshall E. Jennings	Marshall E. Jennings, P. E. 26130	The Lake on Flat Creek	2/27/2004	N.A.	30.2883	-98.4144	Ellenburger-San Saba	Confined	706	0.53	118 - 672	9	24	167.38	Y	239	-39.64	-207.02		Assumed	97	0.00008		0.05		N. A.			Unknown aquifer thickness used for analysis
8	Blanco	1-P	Marshall E. Jennings	Marshall E. Jennings, P. E. 26130	The Preserve at Walnut Springs	10/13/2004	N.A.	30.2450	-98.4864	Ellenburger-San Saba	Confined	324		220 - 285	20	24	4.43	Y	592	-185.12	-189.55	65	Assumed	4,308	0.00009		4.5		pumping at 4.4 gpm, 1.0 feet drawdown 1,000 feet from property boundary after one year		Yes, T. Hard 603, Ca 126, Mg 70, Na 14, SO4 358, Cl 28, F 1.3, TDS 781	
9	Blanco	2(P)	Marshall E. Jennings	Marshall E. Jennings, P. E. 26130	One River Point Subdivision	6/7/2002	N.A.	30.3090	-98.4207	Ellenburger-San Saba	Confined	382	0.53	62 - 382	15	24	54.96	Y	316	-47	-101.96		Assumed	215	0.0002		0.27		pumping at 4.7 gpm, 3.6 feet drawdown 1,000 feet from property boundary after one year		Yes,T Hard 275, Ca 46, Mg 39, Na 14, SO4 79, Cl 11, F 0.2, TDS 363	Unknown aquifer thickness used for analysis
9.1	Blanco	3(P)	Marshall E. Jennings	Marshall E. Jennings, P. E. 26130	One River Point Subdivision	6/7/2002	N.A.	30.3122	-98.4237	Ellenburger-San Saba	Confined	423	0.53	63 - 423	4	24	121.16	Y	189	-4	-125.16		Assumed	1,615	0.0004		0.03		N. A.			Unknown aquifer thickness used for analysis
10	Blanco and Hays Counties	PW 2&3	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Shady Valley Subdivision changed to Silverado Estates, Phase 1, Units	8/10/2002	N.A.	30.2022	-98.2197	Middle Trinity (Hensell/Cow Creek)	Confined	450	0.42	360 - 450	40	24	1.83	Y	500	-254.7	-256.53	30	Assumed	14,650	0.004		21.9		N. A.		No, T. Hard 320, Ca 610, Mg 290, Na 72, SO4 2,200, Cl 66, F 1.9, TDS 3,000, pH 6.9	Estimated monitor well distance

Report #	County	Pump Well ID	Consultant(s)	Certified By	Developer	Pump Test Date	Alternate Location	Lat	Long	Aquifer	Aquifer Type	Pump Well depth	Screen Diam. ft.	Open Interval ft.	Pump Rate gpm	Pump Period hrs	Max-Drawdown ft.	Mon. Well	Dist from pump well ft.	Init. WL ft bgs	Final WL ft bgs	Aquif Thick ft.	Fully Penetrated	T gpd/ft	S	K gpd/ft^2	Spec Cap gpm/ft	Well Effic. (%)	Est. drawdown ft. bgs	Rec. Well Spac.	Chemical Analyses	Comments
10.1	Blanco and Hays Counties	PW-4	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Shady Valley Subdivision changed to Silverado Estates, Phase 1	08/08/2002	N.A.	30.2144	-98.2269	Middle Trinity (Hensell/Cow Creek)	Confined	430	0.42	360 - 430	30	24	1.89	Y	700	-226.12	-228.01	30	Assumed	12,420	0.0001		15.9		3.5 feet decline at 4,000 feet from center of subdivision (pumping well, pumping 30 gpm after 30 years)		No, T. Hard 340, Ca 690, Mg 220, Na 67, SO4 2,100, Cl 58, F 1.9, TDS 3,000, pH 6.8	Estimated monitor well distance
11	Comal	PW	Bond Geological Services	Steve Bond PG 518	Summit Estates Subdivision	12/19/2002	N.A.	29.9786	-98.2640	Middle Trinity (Hensell/Cow Creek)	Confined	370			40	24	44.4	Y	203	-188.69	-233.1	65	Assumed	1,200	0.00001	138 to 2070	0.9		140 feet drawdown at the property boundary after 30 years	200 feet and 84 gpm	Yes, T. Hard 322, SO4 30, Cl 10, F 0.6, TDS 451, pH 7.0	Balcones Fault System southern end of property (160' of displacement)
12	Comal	PW	Bond Geological Services	Steve Bond PG 518	Bear Creek Hills, Lot 28, Subdivision	8/26/2004	N.A.	29.7656	-98.2275	Middle Trinity (Hensell/Cow Creek)	Confined	600	0.32	510 - 562	6.1	24	170	Y	670	-366.86	-537.01	200	Assumed	40	0.00001	0.2	0.04		18.7 feet drawdown at the property boundary after 30 years		Yes, T. Hard 260, SO4 29, Cl 7, F 1.6, TDS 291, pH 7.7	Balcones Fault System near observation well, 10s of feet displacement
13	Hays	Dunn TW-1	Daniel B. Stephens & Associates	Billy Gamblin PE 82640	Faith Ranch	8/24/2005	N.A.	30.1008	-98.1983	Middle Trinity (Hensell/Cow Creek)	Confined	550	0.38	490 - 550	11.6	24	93	Y	390	-387.2	-480.2	30	Assumed	1,035	0.00004	34.4	0.12	42	11.2 feet drawdown at the property boundary after 30 years	300 feet at 11 gpm	Yes, T. Hard 381, SO4 104, Cl 25, F 0.7, TDS 468, pH 7.3	
14	Bell	Salado 1	LBG-Guyton & Associates	Bill Stein AIPG 10441	Hidden Springs at Salado Creek Development	5/18/2001	N.A.	30.9181	-97.6133	Middle Trinity (Hensell Sand)	Confined	820	0.38	760 - 820	30	26.1	36	Y	105	-243.7		20	Assumed	2,230	0.000046	103	0.8		11.2 feet drawdown at the property boundary after 30 years	150 feet	Yes, T. Hard 63, Ca 12, Mg 8, Na 225, SO4 134, Cl 120, F 2.3, TDS 722, pH 7.6	
14.1	Bell	Salado 3	LBG-Guyton & Associates	Bill Stein AIPG 10441	Hidden Springs at Salado Creek Development	05/24/2001	N.A.	30.9381	-97.5828	Middle Trinity (Hensell Sand)	Confined	860	0.38	800 - 860	30	24	28	Y	205	-188.57		20	Assumed	2,050	0.000041	112	1.1		0.5 gpm/well, 17 feet drawdown at the property boundary after 30 years	150 feet	Yes, T. Hard 66, Ca 11, Mg 8, Na 276, SO4 243, Cl 143, F 2.5, TDS 972, pH 7.7	Additional water quality study conducted during 2003
15	Bell	Well 1	Temple Civil Engineering Company	Carl B. Pearson, PE, Susan Worth	Heritage Subdivision	7/21/2003	N.A.	30.9747	-97.4892	Edwards Aquifer	Unconfined?	218	0.38	138 - 218	17	72	27.5	Y	116	-81.1	-108.5	60					0.62		N. A.		Yes, T. Hard 80, SO4 351, Cl 282, F 5.1, TDS 1,380, pH 8.3	No pump test analysis or data
15.1	Bell	Well 2	Temple Civil Engineering Company	Carl B. Pearson, PE, Susan Worth	Heritage Subdivision	7/21/2003	N.A.	30.9744	-97.4886	Edwards Aquifer	Unconfined?	218	0.38	138 - 218	17	72	14.2	Y	116	-83.1	-97.3	135					1.2		N. A.			No pump test analysis or data
16	Bell	Well 1	Kleinfelder	H. L. Fleischhauer, PG 4496	Iduma Trail Subdivision	9/8/2004	N.A.	30.9447	-97.7992	Middle Trinity (Hosston-Sycamore, Hensell Sand)	Confined	537	0.33	480 - 520	11.5	24	101.8	Y	112	-332		40	Did not fully penetrate	112	0.000035	2.6	0.11	76	0.5 gpm/well, 29 feet drawdown at the property boundary after 30 years	100 feet at 1 gpm	Yes, T. Hard 32, SO4 153, Cl 142, F 4.79, TDS 840, pH 8.4	
17	Bell	#2	Bandas Engineering Company	John Hart Bandas, PE 86858	Eagle Creek of Salado	5/8/2004	N.A.	30.9743	-97.5011	Edwards Aquifer	Unconfined?	180	0.38	100 - 180	15	35.8	9.4	Y	110	-84		80	Assumed	352	0.000018		1.6		15 gpm, 15.6 feet drawdown at 500' from the property boundary after 30 years		Yes, T. Hard 159, SO4 156, Cl 109, F 4.66, TDS 758, pH 7.9	
18	Bandera	900' New Well	Strata Geological Services Inc.	William Feathergail Wilson, PG 21	900' Well, Lake Media Shores	1/28/2001	N.A.	29.6353	-98.9856	Sligo and Hosston	Confined	900	0.66	613 - 900	162	36	363	N		-66	-429	279	Assumed	65	0.0045		0.45		N. A.		Unknown, Field measurements of TDS 450 to 500	
19	Johnson (not a GwAS county)	Well #2 (replace-ment)	Collier Consulting Inc	Lynn Smith and Dr. Hughbert Collier	Cleburne State Park	8/17/2000	State Well Grid 32-44-8			Paluxy Formation	Confined	210	0.33	150 - 190	13	36	10.4	N		-156.2		46	Assumed				1.25		N. A.		Yes, T. Hard 290, Ca 11, Mg 3, Na 142, SO4 24, Cl 14, TDS 378, pH 8.3	Not a GwAS county, Very poor pump test results, unable to interpret data
20	Bandera	City of Bandera	Pyle & Klein Consulting Engineers	Unknown	City of Bandera	10/21/1998	State Well Grid 69-24-2, north-central			Trinity?	Confined	770	0.66	610 - 710	280	22	64.69	N		-493	-557.69						4.3		N. A.		Yes, T. Hard 490, Ca 105, Mg 58, Na 107, SO4 30, Cl 270, F 1.8, TDS 940, pH 6.7	No pump test analysis
21	Kendall	Kreutzberg	LBG-Guyton & Associates	Bill Stein AIPG 10441	Cordillera West	7/22/1999	N.A.	29.87	-98.6547	Middle Trinity (Hensell/Cow Creek)	Confined	325	0.5	233 - 325	4.5	24	65	Y	51	-176	-241	80	Assumed	228	0.00026		0.07		N. A.	max. 10 gpm	Yes, T. Hard 316, Ca 55, Mg 44, SO4 98, Cl 27, F 2.0, pH 7.2	
21.1	Kendall	Horseshoe Bend	LBG-Guyton & Associates	Bill Stein AIPG 10441	Cordillera West	7/27/1999	N.A.	29.8697	-98.6469	Middle Trinity (Hensell/Cow Creek)	Confined	330	0.5	230 - 330	5	24	115	Y	56	-174	-289	80	Assumed	75	0.00024		0.04		N. A.	max. 10 gpm	pH 7.2	Pump test results labeled wrong in Table on page 11

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Report #	County	Pump Well ID	Consultant(s)	Certified By	Developer	Pump Test Date	Alternate Location	Lat	Long	Aquifer	Aquifer Type	Pump Well depth	Screen Diam. ft.	Open Interval ft.	Pump Rate gpm	Pump Period hrs	Max-Drawdown ft.	Mon. Well	Dist from pump well ft.	Init. WL ft bgs	Final WL ft bgs	Aquif Thick ft.	Fully Penetrated	T gpd/ft	S	K gpd/ft^2	Spec Cap gpm/ft	Well Effic. (%)	Est. drawdown ft. bgs	Rec. Well Spac.	Chemical Analyses	Comments
21.2	Kendall	Gas Line (Telephone Bldg)	LBG-Guyton & Associates	Bill Stein AIPG 10441	Cordillera West	7/24/1999	N.A.	29.8661	-98.6394	Middle Trinity (Hensell/Cow Creek)	Confined	292	0.5	200 - 292	4.4	24	13	Y	58	-147	-160	80	Assumed	378	0.00032		0.23		N. A.	max. 10 gpm	Yes, T. Hard 340, Ca 59, Mg 47, SO4 163, Cl 33, F 2.6, pH 7.2	Pump test results labeled wrong in Table on page 11
22	Travis	Well 1 Location Well 2# pumping	GEOS Consulting	John Mikels, AIPG 7445	Saint Andrews High School, Well #2 Pump Test, Austin, Tx	6/10/2001	N.A.	30.2469	-97.8531	Middle Trinity (Hensell/Cow Creek)	Confined	960			36.9	24.7	245.82	Y	176	-260.88	-506.7		Assumed	130	0.00038		0.15		15.2 gpm, 13 feet drawdown at 5,000' from pumping wells 1 and 2 after 20 years		No, T. Hard 2,018, Ca 470, Mg 205, Na 22, SO4 1,570, Cl 19, F 2.7, TDS 2,740, pH 7.1	Confusing analysis, near Mt. Bonnell Fault (few hundred feet)
23	Hays	RMR Testwell	GEOS Consulting	John Mikels, AIPG 7445	River Mountain Ranch, Section 6, Phase 2	7/5/2001	N.A.	30.0101	-98.0111	Middle and Upper Trinity	Confined	1,030	0.66	185 - 1,025	100	31.8	72.72	Y	1,200	-307.75	-380.47		Assumed	200	0.000012		1.38		N. A.		Yes, T. Hard 470, SO4 185, Cl 37, F 1.4, TDS 684, pH 7.3	Monitor Well 95% of pumping well, Very slow recovery, fracture controlled
24	Kerr (not a GwAS county)	Well #1	Strata Geological Services Inc.	William Feathergail Wilson, PG 21	Turtle Creek Area	6/25/2001	N.A.	29.9514	-99.0899	Lower Glen Rose and Hensel Sand	Confined	282	0.33	261 - 282	10.3	6.6	9.97	N		-169.6	-179.57	18	Partially penetrated	1,175	0.055	65	1.0		N. A.		Yes, T. Hard 438, SO4 159 Cl 21, F 1.7, TDS 600, pH 7.3	Not a GwAS county, Short pump test with no monitor wells, WLs rise during pump test?
24.1	Kerr (not a GwAS county)	Well #2	Strata Geological Services Inc.	William Feathergail Wilson, PG 21	Turtle Creek Area	6/26/2001	N.A.	29.9463	-99.0910	Lower Glen Rose and Hensel Sand	Confined	362	0.5	299 - 362	13.2	6.6	11.17	N		-204.14	-215.31	61	Assumed	114	0.000189	1.9	1.2		N. A.		Yes, T. ard 424, SO4 158 Cl 10, F 0.6, TDS 592, pH 7.3	Not a GwAS county, Short pump test with no monitor wells, WLs rise during pump test?
25	Bandera	Well Set #2	Strata Geological Services Inc.	William Feathergail Wilson, PG 21	Medina Springs Subdivision	11/19/2002	N.A.	29.8167	-99.2716	Hensell Sand and Cow Creek Limestone	Confined	460		426 - 460	14.2	24	112.87	Y	100	-98.64	-211.52	45	Assumed	87	0.00014	1.9	0.125	50	20 feet drawdown at subdivision boundary after 20 years	10 gpm at 1,000 ft spacing	Yes, T. Hard 470, SO4 400, Cl 10, F 1.2, TDS 694, pH 7.2	No information on monitor wells results
25.1	Bandera	Well Set #4	Strata Geological Services Inc.	William Feathergail Wilson, PG 21	Medina Springs Subdivision	11/27/2002	N.A.	29.8161	-99.2808	Hensell Sand and Cow Creek Limestone	Confined	555		491 - 555	10.8	24	155.22	Y	100	-173.4	-205.4	155	Assumed	53	0.00018	0.9	0.07	50	20 feet drawdown at subdivision boundary after 20 years	10 gpm at 1,000 ft spacing	No, T. Hard 280, Ca 33, Mg 230, Na 41, SO4 780, Cl 69, F 3.7, TDS 1,600, pH 7.1	No information on monitor wells results
26	Hays	Well #1	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Heather Hills Subdivision	2/11/2001	N.A.	30.2602	-98.1079	Sligo and Hosston Formations	Confined	780	0.38	660 - 760	7.3	24	173.84	Y	530	-317.01	-490.85	300	Assumed	120	0.0003	1.5	0.04		4.7 gpm, drawdown of 27 feet at 4,000 feet from center of subdivision		No, T. Hard 1,946, Ca 400, Mg 230, Na 69 SO4 1,500, Cl 78, F 2.8, TDS 2,800, pH 7.4	
27	Hays	Pumping Well	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Valley Verde Subdivision	8/22/2000	N.A.	30.1968	-98.2169	Hensell Sand and Cow Creek Limestone	Confined	455	0.42	360 - 455	30	28	5.06	Y	600	-317.3	-322.36	100	Assumed	2,200	0.008	20.9	5.9		0.3 gpm/well, Drawdown of 1 foot at 2,000 feet beyond boundary of subdivision after 20 years		No, T. Hard 260, Ca 370, Mg 220, Na 51, SO4 1,500, Cl 44, F 1.9, TDS 2,500, pH 7.2	
28	Hays	Pumping Well	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Westridge Subdivision	3/17/2000	State Well Grid 57-47-9			Cow Creek Limestone	Confined	440	0.38	340 - 390	30	24	48.02	Y	400	-262.52	-310.54	50	Assumed	1,336	0.015	15	0.63		0.3 gpm/well, drawdown of 5 feet at 2,000 feet from center of subdivision after 20 years		Yes, T. Hard 316, SO4 15, Cl 12, F 0.2, TDS 392, pH 7.6	Intense thunderstorm during first 4 hrs of test
29	Bandera	Well 2 (pair, #1)	Chapman Engineering	Calvin C. Chapman, P.E 81268	Mason Creek Vist Subdivision	1/30/2001	N.A.	29.7772	-99.0310	Lower Glen Rose and/or Cow Creek Limestone	Confined	480	0.5		16	18	88.4	Y	100	-40		60	Assumed	8,370	0.00319	110.7	0.18	28	N. A.		Yes, T. Hard 293, SO4 60, Cl 32, F 0.7, TDS 456, pH 7.1	Total demand and Specific Capacity are calculated wrong. Missing pump converted data, estimated monitor well distance
30	Bandera	WW#2	Chapman Engineering	Calvin C. Chapman, P.E 81268	Water Well 1 and 2 Merritt Subdivision, Pipe Creek	5/25/1999	N.A.	29.7006	-98.9554	Hensell Sand and Cow Creek Limestone	Confined	460	0.38	360 - 460	17.7	3.5	10.14	N		-133.15	-143.29	50	Assumed	17	0.00015	0.3	1.7		N. A.		Yes, T. Hard 276, SO4 56, Cl 36, F 0.6, TDS 478, pH 7.0	Short pump test, no monitor well,
30.1	Bandera	WW#1	Chapman Engineering	Calvin C. Chapman, P.E 81268	Water Well 1 and 2 Merritt Subdivision, Pipe Creek	5/24/1999	N.A.	29.6998	-98.9503	Hensell Sand and Cow Creek Limestone	Confined	440	0.38	360 - 440	18.9	3.5	14.59	N		-145.21	-159.8	50	Assumed	26	0.00015	0.3	1.3		N. A.		No, T. Hard 1,378, SO4 799, Cl 45, F 4.0, TDS 1,300?, pH 6.9	Short pump test, no monitor well
31	Bandera	Well #2	Strata Geological Services	William Feathergail Wilson, CPG #3566	Bear Springs Trails, Section 1	3/9/2000	N.A.	29.7378	-98.9361	Hensell Sand and Cow Creek Limestone	Confined	540	0.38		32	5.1	74.02	N		-228.01	-302.03	25	Assumed	352	0.00035	14	0.4		N. A.		N.A.	Short Pump Test, no monitor well
32	Bandera		Environmental Fuel Systems, Inc (combined with # 21)	William Feathergail Wilson, CPG #3566	Madrona Ridge Subdivision	3/12/1998	N.A.	29.6551	-99.0157	Glen Rose	Confined	505	0.38	145 - 505	14.2	4	38.8	N		-248.25	-287.05	230	Assumed	106	0.149	0.5	0.37		N. A.		N.A.	Missing pump WL converted data, short pump test, no monitor well

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Report #	County	Pump Well ID	Consultant(s)	Certified By	Developer	Pump Test Date	Alternate Location	Lat	Long	Aquifer	Aquifer Type	Pump Well depth	Screen Diam. ft.	Open Interval ft.	Pump Rate gpm	Pump Period hrs	Max-Drawdown ft.	Mon. Well	Dist from pump well ft.	Init. WL ft bgs	Final WL ft bgs	Aquif Thick ft.	Fully Penetrated	T gpd/ft	S	K gpd/ft^2	Spec Cap gpm/ft	Well Effic. (%)	Est. drawdown ft. bgs	Rec. Well Spac.	Chemical Analyses	Comments
33	Kinney (not a GwAS county)	Well #1	URS/Dames and Moore	Unknown, (G. L. Snyder, URS?)	Bitters Farm (Dooley Estate, Irrigation wells 2 and 3)	3/30/2001	N.A.	29.3786	-100.4631	Edwards Aquifer, Salmon Peak, McKnight and West Nueces	Confined	1,112	0.71	360 - 1,112	1,860	36		Y	2,840	14.0		700	Assumed	279,100	0.000016	449			N. A.		No, T. Hard 213, Mg 206, Na 184, SO4 1,550, Cl 179,F 2.9, TDS 2,890, pH 7.3	Not a GwAS county, Wells are artesian, 14' above surface, no pump test raw data
34	Hays	Test Well #1	LBG-Guyton & Associates	Bill Stein, 10441 AIPG	Bridlewood Ranches Development	3/5/2003	N.A.	29.8956	-98.0595	Glen Rose and Cow Creek Limestone	Confined	1,100	0.42	400 - 420, 1,060 - 1,100	29	24	0.75	Y	238	-297.84	-298.59	100	Assumed	6,600	0.0001	66	38.5		Drawdown of 23 feet at 1,000 feet from the perimeter of subdivision after ?? years		No, T. Hard 320, Ca 450, Mg 85, Na 10, SO4 1,300, Cl 20, F 2.4, TDS 2,000, pH 6.8	No raw pump test data.
35	Hays	PW2	The Wellspec Company and Bond Geological Services	Joe J. Vickers PG 1543 and Steve Bond PG 518	Woodlands Estates II	4/11/2000	State Well Grid 57-39-6			Hensell Sand and Cow Creek Limestone	Confined	410	0.5	20 - 410	35	24	1.36	Y	800	-170	-171.36	40	Assumed	9,600	0.034		25		Drawdown of 1.5 feet (162 gpm) at 3,000 feet from the pumping well after 10 years		No, T. Hard 207, Ca 132, Mg 97, Na 257, SO4 904, Cl 145, F 0.9, TDS 1,610, pH 7.6	No well locations or raw pump data
36	Hays	PW-1	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Frontera Subdivision	11/12/2004	N.A.	30.2536	-98.0346	Lower Trinity	Confined	770	0.42	695 - 755	11	24	20.11	Y	660	-509.98	-530.09	200	Partially penetrated	2,000	0.001	20	0.55		3.1 gpm/well, Drawdown of 1 foot at 6,000 feet from the perimeter of subdivision after 30 years		Yes, T. Hard 511, Ca 90, Mg 70, Na 16, SO4 222, Cl 13, F 2.5, TDS 795, pH 7.1	
37	Hays	No. 2 Well	GEOS Consulting	John Mikels, AIPG 7445	Sierra West, Sec 2A	5/13/2000	N.A.	30.0597	-97.9960	Hensell Sand and Cow Creek Limestone	Confined	940	0.83	105 - 930	229	25	236.4	Y	750	-217.18	-453.58	70	Assumed	2,800	0.000025	43	0.97		Drawdown of 60 feet (162 gpm) at 5,280 feet from the pumping well after 20 years		Yes, T. Hard 422, Ca 60, Mg 66, Na 27, SO4 142, Cl 10, F 3.6, TDS 620	
38	Hays	PW-1	The Wellspec Company and Banks and Associates	Joe J. Vickers and Erin Banks PE 84248	High View Ranch	4/25/2003	N.A.	30.0846	-98.0872	Middle Trinity, Cow Creek	Confined	560	0.42	60 - 560	12.7	24	19.62	Y	750	-388.73	-408.35	40	Partially penetrated	525	7.34E-05		0.65		Maximum drawdown of 6 feet (at 3 gpm) at lots 5 and 7 after 30 years		Yes, T. Hard 619, Ca 118, Mg 79, Na 27, SO4 156, Cl 10, F 2.9, TDS 611	
39	Hays	PW-1	Banks and Associates	Erin Banks PE 84248	Kelly's Country Subdivision	10/13/2004	N.A.	30.0689	-98.0923	Middle Trinity, Cow Creek	Confined	460	0.42	260 - 460	12.5	23.5	41.73	Y	500	-327.02	-368.75	135	Assumed	355	1.86E-05		0.3		Drawdown of 46.5 feet (1.2 gpm) at southern subdivision boundary after 30 years		Yes, T. Hard 372, Ca 76, Mg 44, Na 17, SO4 69, Cl 18, F 0.6, TDS 494, pH 7.7	
40	Hays	New Well	GEOS Consulting	John Mikels, AIPG 7445	Mt. Sharp Ranch	2/6/2000	N.A.	30.0943	-98.1737	Lower Trinity, Hosston	Confined	430	0.42	380 - 430	34	24.6	5.6	Y	660	-300.65	-306.3	100	Partially penetrated	4,000	0.00007		6.1		Drawdown of 2.2 feet (0.3 gpm/well) at 2,000 ' past property boundary after 20 years		No, T. Hard 490, Ca 250, Mg 170, Na 13, SO4 730, Cl 26, F 3.3, TDS 2,100, pH 6.9	
41	Hays	PW-1/ Well 5	Banks and Associates	Erin Banks, PE 84248	Goldenview Estates Subdivision	4/13/2001	N.A.	30.1463	-97.9715	Middle Trinity, Cow Creek	Confined	650	0.42	560 - 650	14	24	36.85	Y	463	-231.18	-268.03	40	Assumed	972	0.005				Drawdown of 2.9 feet (0.3 gpm/well, at subdivision Lots 6 and 7 boundary after 10 years		Yes, T. Hard 749, Ca 136, Mg 100, Na 48, SO4 500, Cl 48, F 2.6, TDS 854, pH 7.1	No scale on maps
42	Hays	PW-1	Banks and Associates	Erin Banks, PE 84248	Homestead at Gatlin Creek	5/3/2003	N.A.	30.1316	-98.1399	Middle Trinity, Cow Creek	Confined	500	0.48	288 - 447	20	24	4.94	Y	538	-251.79	-256.73	60	Assumed	3,000	1.03E-05		4.1		Drawdown of 1.7 feet (0.3 gpm/well, at subdivision boundary Lot 3a after 30 years		No, T. Hard 292, Ca 331, Mg 211, Na 75, SO4 1,380, Cl 59, TDS 2,000	Drawdown higher in observation well, possibly local pumping
43	Hays	PW-1	The Wellspec Company and Bond Geological Services	Joe J. Vickers and Steve Bond PG 518	Walking W Ranch Subdivision	3/14/2003	N.A.	30.2888	-98.0962	Middle Trinity, Hensell and Cow Creek	Confined	590	0.42	480 - 580	13	24.3	12.96	Y	620	-450.46	-463.42	75	Assumed	2,300	0.00005	31	1		Drawdown of 10.5 feet (20 gpm) at 4,000' from center of subdivision after 30 years		Yes, T. Hard 490, Ca 82, Mg 76, Na 27, SO4 169, Cl 20, F 3.4, TDS 565	
44	Hays	No. 1 Well	GEOS Consulting	John Mikels, AIPG 7445	Running Rope No. 1 Test Well	10/13/1999	N.A.	30.0523	-97.9952	Upper Trinity Aquifer	Confined	460	0.5	40 - 460	30	28.8	53.7	Y	508	-137.3	-191	20	Assumed	231	0.000013		0.56		Drawdown of 33 feet (3.5 gpm) at 5,000 feet from pumping well after 20 years		No, T. Hard 1,033, Ca 196, Mg 132, Na 15, SO4 1,175, Cl 19, F 2.8, TDS 1,713	Pump test results indicated possible local faulting, 500 ft throw.
45	Hays	PW-1	Banks and Associates	Erin Banks, PE 84248	Cielo Ranch Subdivision	10/22/2004	N.A.	29.9253	-98.1198	Middle Trinity, Cow Creek	Confined	860	0.42	840 - 860	9	22.5	103.35	Y		-467.55	-570.9	120	Assumed	225	0.00001		0.09		Drawdown of 15.6 feet at (3.75 gpm) at 2,000 feet from pumping well after 30 years (revised)		Yes, T. Hard 325, Ca 53, Mg 47, Na 21, SO4 156, Cl 10, F 3.4, TDS 664	Erratic monitor well response to pump test, 200' difference in static water levels

Report #	County	Pump Well ID	Consultant(s)	Certified By	Developer	Pump Test Date	Alternate Location	Lat	Long	Aquifer	Aquifer Type	Pump Well depth	Screen Diam. ft.	Open Interval ft.	Pump Rate gpm	Pump Period hrs	Max-Drawdown ft.	Mon. Well	Dist from pump well ft.	Init. WL ft bgs	Final WL ft bgs	Aquif Thick ft.	Fully Penetrated	T gpd/ft	S	K gpd/ft^2	Spec Cap gpm/ft	Well Effic. (%)	Est. drawdown ft. bgs	Rec. Well Spac.	Chemical Analyses	Comments
46	Hays	P, Lot 23	Marshall E. Jennings	Marshall E. Jennings, PE 26130	The Vineyard Subdivision	6/1/2005	N.A.	30.1071	-98.0811	Middle Trinity, Lower Glen Rose, Hensell and Cow Creek	Semi-confined	460	0.38	390 - 450	35	24	67.29	Y	668	-228.78	-296.07	20	Assumed	970	0.00002		0.52		Drawdown of 19.0 feet at (0.25 gpm/well, no recharge) at 2,000 feet from pumping well after 10 years	Drill wells to a depth of 450 ft.	Yes, T. Hard 168, Ca 34, Mg 20, Na 17, SO4 21, Cl 10, F 0.9, TDS 304, pH 7.1	Possible recharge boundary, Gatlin Creek 2,500 feet, 1 to 2 inches of rain during test
47	Hays	Well 3	Premier Hydro	Scott Courtney, PG 6413	Las Misiones Hill Country Estates	5/25/2005	N.A.	29.9865	-98.1610	Middle Trinity, Lower Glen Rose, Hensell and Cow Creek	Confined	450	0.33	100 - 450	61.2	24		Y	320	-58.5		340	Assumed	12,700	0.00095	32.2			Drawdown of 0.5 feet at 24 gpm at 5,000 feet from pumping well after 30 years		Yes, T. Hard 322, SO4 47, Cl 12, F 1.3, TDS 343, pH 7.1	Leaking packer suspected 240 min into pump test, no raw pump test data
48	Hays	TW-1	Daniel B. Stephens & Associates	Billy Gamblin, PE 82640	The Oaks at Gatlin Creek	2/2/2005	N.A.	30.1216	98.0980	Middle Trinity, Travis Peak Hensell	Confined	400	0.38	360 - 400	14	24	10.96	Y	600	-142		40	Assumed	3,600	0.00025	90.5	1.28	85	Drawdown of 1.3 feet at (0.42 gpm/well) at property boundary after 30 years	300 feet at 14 gpm		
49	Guadalupe	Observ. Well	Southwest Engineers	Kaveh Khorzad	Crystal Clear WSC		Observation Well coordinates	29.6525	-97.8286	Wilcox	confined					1.1	64.33	Y		117.33		141	Assumed	1,160	9.08E-10				N. A.			Partial report received
50	Bandera	Holiday #1	Strata Geological Services	William Feathergail Wilson, CPG #3566	Tecon, Public Water well	1/28/2001	N.A.	29.6353	-98.9856	Hosston	confined				162	36		N				279	Assumed	655	0.0045	2.3			N. A.			
51	Gillispie	CWR-2A	Strata Geological Services	William Feathergail Wilson, CPG #3566	Cool Water Ranch - 2	4/9/2005	N.A.	30.3125	-98.7550	Hensel	confined			60	9.7	12		Y	150			197	Assumed	111	0.041	0.6			N. A.			No drawdown in monitor well, pumping well in isolated channel facies
52	Gillispie	Well 1	Strata Geological Services	William Feathergail Wilson, CPG #3566	The Vineyard	7/26/2005	N.A.	30.2800	-98.8942	Hensel	confined				21.3	12	0.5	Y	150			80	Assumed	10,850	0.00784	136.1			N. A.			e-line collected data after transducer failed, 12 hour pump test, personal communication
53	Kendall	West #5	LBG-Guyton & Associates	Bill Stein AIPG 10441	KWW West	12/20/1999	N.A.	29.8661	-98.5664	Middle Trinity, Cow Creek	confined	252	0.33	185 - 252	5	24	12	Y	53	-131	-143	60	Assumed	307	0.00011		0.4		N. A.	10 gpm/well	Chemical data missing from copy of report, pH 7.1	Very detailed analyses of pumping scenarios
53.1	Kendall	West #6	LBG-Guyton & Associates	Bill Stein AIPG 10441	KWW West	12/27/1999	N.A.	29.8669	-98.5906	Middle Trinity, Cow Creek	confined	252	0.33	185 - 252	7	24	30	Y	49	-137	-167	60	Assumed	310	0.00018		0.2		N. A.	10 gpm/well	Chemical data missing from copy of report, pH 7.3	Very detailed analyses of pumping scenarios
53.2	Kendall	West #9	LBG-Guyton & Associates	Bill Stein AIPG 10441	KWW West	2/1/2000	N.A.	29.8742	-98.5933	Middle Trinity, Cow Creek	confined	252	0.33	185 - 252	7	24	19	Y	51	-145	-164	60	Assumed	295	0.0021		0.4		N. A.	10 gpm/well	Chemical data missing from copy of report, pH 7.2	Very detailed analyses of pumping scenarios
54	Kendall	Waterstone #1	LBG-Guyton & Associates	Bill Stein AIPG 10441	Waterstone Development	6/15/2000	N.A.	29.8961	-98.5372	Lower Trinity, Hosston Sand	confined	480	0.42	240 - 280	24	24	60	Y	265	-84	-144	300	Assumed	1,060			0.4		N. A.	10 gpm/well	Chemical data missing from copy of report, pH 7.2, Spec. Cond. 1,930	Very detailed analyses of pumping scenarios
54.1	Kendall	Waterstone #2	LBG-Guyton & Associates	Bill Stein AIPG 10441	Waterstone Development	10/19/2000	N.A.	29.8858	-98.5547	Middle Trinity, Cow Creek	confined	452	0.42	300 - 452	10	24	6	Y	51	-78.5	-84.5	60	Assumed	5,280			1.7		N. A.	10 gpm/well	Chemical data missing from copy of report, pH 7.5, Spec. Cond. 1,780	Very detailed analyses of pumping scenarios
54.2	Kendall	Waterstone #3	LBG-Guyton & Associates	Bill Stein AIPG 10441	Waterstone Development	5/23/2000	N.A.	29.9028	-98.5547	Lower Trinity, Hosston Sand	confined	500	0.42	415 - 500	42	24	210	Y	49	-80	-290	300	Assumed	410	0.00025		0.2		N. A.	10 gpm/well	Chemical data missing from copy of report, pH 7.2, Spec. Cond. 2,360	Very detailed analyses of pumping scenarios

Appendix 3

Guidelines for Hydrogeologic Reports and Tests Conducted Within the Jurisdictional Boundaries of the Barton Springs / Edwards Conservation District

Guidelines for Hydrogeologic Reports and Tests Conducted Within the Jurisdictional Boundaries of the Barton Springs / Edwards Conservation District

January 2007

I. Introduction

In accordance with the District's Rules and Bylaws and the District's Well Construction Standards, a hydrogeologic report may be required as part of the application for a pumping permit or increase in the permit, constructing, drilling, or modifying nonexempt wells. These guidelines are intended to assist professionals involved in conducting hydrogeologic studies (and the associated test) of existing and proposed groundwater pumping systems in the Barton Springs segment of the Edwards . These guidelines provide some standards and District expectations of the hydrogeologic studies, and have been prepared with consideration for the local hydrogeologic conditions typically experienced in the region. Planning and implementation of the test shall be closely coordinated with the District to insure that the proposed study is consistent with District standards, however, the groundwater professional conducting the investigation is solely responsible for the accuracy and validity of the report. Prior to the commencement of the hydrogeologic investigation the District shall approve a written work plan that describes the design, approach, potential uncertainties, and remedies to those uncertainties. An approved work plan shall include all components of the District guidelines for hydrogeologic reports and tests in the Barton Springs Segment of the Edwards , but is not limited only to these guidelines. Deviation from these guidelines may occur with District approval and should be addressed in the work plan. District staff may recommend that permit requests be rejected due to hydrogeologic reports that do not meet the District standards outlined below.

II. Purpose and goals of the Hydrogeologic Study

Hydrogeologic studies provide essential information for water-resource management for both the District and the permittee. As new water-use systems and increased demands are added to the Edwards, hydrogeologic studies (and tests) are an essential tool to assess and document the potential influences on local wells and to understand the local characteristics.

The primary goals of the hydrogeologic report that must be addressed in the report are summarized below:

1. Properties: Hydrogeologic parameters including transmissivity and storage need to be calculated from an test. From these parameters, the report should estimate the effects of current and projected pumpage on the water levels on surrounding wells for a one and three year period, unless otherwise specified by the District. Additionally, the report should also identify the presence of nearby hydrogeologic barriers, specific recharge features, public water supplies, or other factors that may influence this pumpage over time.

2. Impacts To Wells: The study should produce a map of the maximum drawdown from the test for the surrounding monitored wells.

3. Changes in Water Quality: The study should indicate if water quality changes are likely to occur as a result of future pumping demands. In cases where pumping wells are located near the bad-water line or in an area where significant contribution may be received from the Glen Rose or other s of differing and distinguishable water quality, field and lab measurements shall be performed in conjunction with an test to assess possible water quality changes.

III. Aspects of the Hydrogeologic Report and Test Guidelines

Below are some aspects of the hydrogeologic report that must be addressed for the District to adequately assess the report. test guidelines (collection and analyses of data) should follow those discussed in Driscoll (1986) and Kruseman and de Ritter (1991), or other published sources.

A. Description of the Well Site and Water System

The report must present a description of the project and indicate, using text and maps, the location of the well site(s) and site-system configuration. A description of the current and anticipated annual pumping demands should be addressed along with typical pumping schedules, such as, frequency, duration, peak demand hours, and pumping rates of the pumped well. The location and volume of water-storage facilities on and adjacent to the well site should be discussed.

B. Geology & Description

The geologist or hydrogeologist should provide a description of their hydrogeologic conceptual model. This should include discussion on hydrogeologic aspects of the , such as the conditions (e.g. confined, semi-confined, unconfined), thickness and lateral continuity. Evidence to support this model must include a geologic and hydrogeologic stratigraphic description of the well site and surrounding area prepared by the geologist or hydrogeologist. A geologic map and cross sections illustrating the outcropping geologic units well bore geology, structural features (faults), and potential recharge influences on groundwater flow must be provided. In general, the cross sections should be aligned perpendicular and parallel to the direction of regional faulting. Pre-pump test potentiometric surfaces, maximum drawdown, and theoretical maximum drawdown for 3 years should be shown on the cross sections. Geologic and hydrogeologic information may be derived from drilling logs, state well records, geotechnical borings, geophysical logs, site mapping of outcrops (by a qualified geologist), surface geophysical methods, and in conjunction with published geological maps. A potentiometric map should be prepared showing the elevations of the potentiometric surface of the proposed for usage. The potentiometric map should be based on water-level measurements taken within a 2-week period prior to the test. The water- level measurements should be limited to wells screened in the same , unless impacts between s are being assessed.

C. Inventory of potential recharge and discharge locations

The report must include an inventory of all known wells (private and public water source), surface ponds or reservoirs, major karst features, springs, or any other source of water recharge and

discharge for the project well site and surrounding area. The area this inventory covers will vary according to each test, and the District Assessment staff shall be consulted as to the area of the survey prior to the test. However, it should be noted that previous pump tests in confined portions of the have demonstrated that large pumping rates over several days can result in measurable drawdown for over a 2-mile distance. Drilling and geophysical logs, and state well records from area wells should be included in the appendices of the report.

D. Public Notice

Collecting data in sufficient amounts and of the highest quality during the test is critical for accurate assessment of the results. The applicant must ensure that adjacent well owners who are interested in participating in the test (for example, as observation well locations) are aware of the test and that their participation is included in the test if it provides useful additional data and information. Therefore, a public notice approved by the District and sent certified mail is required for all hydrogeologic studies (tests) and shall be provided to all adjacent property owners within a ½ mile radius of the well to be tested. Notification of any property owner served by a retail water utility is not required if notice is provided to the water utility. The applicant will provide public notice via certified mail to all adjacent recipients and publish in a newspaper of general circulation within the District twenty (20) days before conducting the hydrogeologic study (test).

E. Test: Design and Operation

The report should describe the configuration and methodology of the test. All test data, including date and time, measured discharge rate, drawdown, and field comments should be presented in the Appendices (and a copy provided in digital spreadsheet form). Any problems encountered in the field must be discussed and documented. Guidelines for various aspects of testing in the District are presented below:

Duration and Pumping Rate of the Test: The date and time of starting, stopping, and pumping rate of the test must be clearly stated in the work plan and in the report. The duration and rate of pumping of the test should be sufficient to predict the long-term response to pumping and impacts to wells. (Driscoll, 1986) The District determines the duration of the test by the volume of water requested on the permit and the flow rate capability of the pumping well. To adequately stress the , the test shall be designed to pump a minimum of three times the daily equivalent of the requested annual permitted volume. For example, if the requested permitted volume of groundwater is 50,000,000 gallons; the daily equivalent of pumped groundwater would be 136,986 gallons. Therefore, the amount of water pumped during the test should be three times that volume, or 410, 958 gallons. For an test conducted over a 24-hour period, the flow rate would be about 285 gallons per minute. Note that the pumping rates chosen for the test should not be the maximum allowed by the system so as to ensure that the pump can be adjusted to maintain a constant pumping rate as the water level drops in the well.

During the test, discharge should be measured accurately and frequently enough to verify that a constant discharge rate is being achieved. If a flow meter is used to measure flow, it should be calibrated prior to the test and verified using another calculation method, such as an orifice weir, or by the time required to fill a storage facility of known volume. Waste of the discharge should be

avoided as much as possible, particularly during low water-level conditions in the and should be routed to storage tanks or to other water systems when possible. If the water must be discharged to surface drainages off-site, the pumped water should be routed so that it does not recharge into the tested in the vicinity of the pumping well during the test.

Aggregate Well Fields: If the study involves the assessment of two or more pumping wells, each well may be pumped separately to measure their combined effects. If the wells are sufficiently close, it may be possible to pump the wells simultaneously. Pumping each well separately, and allowing sufficient time for recovery between tests, can more accurately measure parameters.

1. Number and Location of observation wells: Observation wells should be selected radially around the pumping well, although drawdown measurements should be focused on wells where the greatest drawdown is anticipated, such as following along strike of the dominant fault trend. The location of observation wells will vary depending if conditions are confined or unconfined. The number of monitor wells will vary depending on the scale of the test and accessibility. Note that the district can help locate monitor wells and acquire access when applicable.

2. Water-Level Data: Pre- and post- test water-level measurementsshould be collected to adequately document local background conditions in the . All water-level measurements should be within 0.01 feet precision. Precipitation and stream flow on the recharge zone (from USGS flow stations) should be reported during the test. tests should not be conducted during or immediately after significant rain events, because of the rapid change in water levels that often follows in this . Because water levels are dropping rapidly within the first several hours of pumping, water level measurements should be taken frequently. The use of automated data loggers and pressure transducers should be used whenever possible and verified with frequent manual e-line measurements Arrangements need to be made and testing schedules should be coordinated with other area pumping wells to avoid pumpage interferences that could result in misleading or uncertain results. The District can help coordinate these efforts.

3. Recovery: The recovery of water levels in the pumping and observation wells should be monitored immediately following the pumping period until all of the wells reach at least 90% of their original water level or have achieved a constant level for 2 hours. Data from the recovery phase should be nearly a mirror image of the pumping phase data when plotted arithmetically.

Note: Incomplete recovery and deviations from the theoretical recovery trends should be addressed. Several of the monitored wells should be measured beyond the recovery period of the pumping phase to establish regional and local water level trends.

F. Analyses of Test Data

This section should be prepared by a groundwater professional describing the hydrologic information and the methods used to characterize the and discuss the limitations of the data and analyses. parameters are generally measured using an test. However, other methods of

estimating parameters exist, such as, those based on grain size or geophysical response of the rock matrix, or the specific capacity of the well. These methods are generally insufficient alone to provide accurate measurement of the properties, but may be used to provide supplemental information.

1. Presentation of the water-level data should include a graph of the arithmetic (non-log) water-level elevation versus time for all the data from each well. From these graphs, long- and short-term trends, the lack of full recovery of water levels, and evidence of boundaries can be addressed.

2. Discussion of the analyses and methods used to calculate transmissivity and storage coefficients must be presented. Most commonly, curve-matching techniques are applied to achieve the optimal fit between theoretical relationships (e.g. Theis) and measured field data. Numerical modeling of pumptest data has also been developed (e.g. MODFLOW and RADFLOW), and can be used in conjunction with curve-matching techniques (see Johnson et al., 2001).

Semi-log and log-log graphs of drawdown versus time must show the measured data and the theoretical curve used to calculate the parameters. All data manipulation should be clearly described. Most importantly, deviations from these theoretical curves must be addressed and may include issues, or violations of assumptions, such as: recharge, partial penetration of wells, fluctuating pumping rate, delayed yield, leakage, atmospheric responses, regional water-level trends, and interference from other wells.

G. Evaluation of Potential Water-Level and Quality Impacts

The effects of pumpage from the investigated wells on the and surrounding wells must be evaluated.

1. A map of the maximum measured drawdown and discussion about how those numbers were determined must be provided. If more than one well is pumped, the maximum drawdown from each test should be shown separately, and the drawdown effects of each test may be summed, if appropriate, in each observation well and presented in a separate map. Regional water-level trends and spring flow at Barton Springs should be discussed. These data can be obtained from the District. Maximum drawdown determinations may need to be adjusted for regional water level trends.

2. The calculation of transmissivity and storage coefficients can be used to predict future water-level declines for a given time period and pumping rate. These theoretical graphs showing drawdown over distance, such as the modified Cooper-Jacob Equation, are a useful tool to evaluate the effects of future pumping on surrounding well owners and public water supplies. A map of this theoretical drawdown shall be presented in the report for given time periods.

3. Additionally, the report should document and discuss any water-quality trends that may have occurred due to the groundwater withdrawals. Analytical results should be

provided in the appendices. Arrangements can be made with the District to take field and some basic laboratory measurements in conjunction with an test.

H. Supplemental Information

Due to the test-specific nature of these investigations, additional information can significantly enhance the results of the investigation. Below are some items that should be considered within the scope of work for the hydrogeologic studies:

1. In the absence of good geological and geophysical control data, a suite of geophysical logs (and down-hole camera) should be performed on the pumping well.
2. In the absence of sufficient observation wells, a scientific monitor well (borehole) should be completed in the well field.

References

Driscoll, Fletcher R., 1986, Groundwater and Wells. Second Edition. Johnson Screens, St. Paul, Minnesota. Pp. 1089.

Johnson, G.S., D.M. Cosgrove, and D.B. Frederick, 2001. A Numerical Model and Spreadsheet Interface for Pumping Test Analysis, Groundwater, July-August 2001, Vol. 39, No. 4, Pp. 582-592.

Kruseman, G.P., and N.A. de Ridder, 1991, Analysis and Evaluation of Pump Test Data, Second Edition, ILRI, Netherlands. 377 p.

Acknowledgments

This document is modified from original guidelines written by former District Hydrogeologist Nico Hauwert, P.G. These guidelines have been modified by Assessment Staff Dr. Brian A. Smith, P.G., Brian Hunt, P.G., and Joseph Beery.

Appendix 4

Compact Disk Containing Scanned Pumping Test Reports